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WESTINGHOUSE REHABILITATION.

It must be a matter of congratulation with all well wishers of the electrical industries that the Westinghouse plan of reorganization has now been carried out, and that the company starts anew with abundant funds, unimpaired facilities for production, an experienced, loyal staff, and every prospect of a business larger in the future than at any time in the past. The cycle of depression has closed on itself, and a new period of prosperity opens up, in whose advance and development electricity will by no means play a minor part. In fact, to the watchful observer with any familiarity with the facts, no condition is more evident than the increasing magnitude of electrical business, predicated not simply on the growth of wealth and population, but upon the permeating tendency to employ electrical agencies in all the great departments of modern life. Mr. Westinghouse has always been an enthusiastic believer in this process of expansion; once or twice he may somewhat have miscalculated its rate, or, in the zeal of endeavor, have forgotten that times of recession must come. But, in the ultimate analysis, his instincts have been true, for the art goes ever forward; while he himself is one of those whose recoil only helps the next upward leap.

ELECTRIC LIGHTING OF STEAM RAILROAD CARS.

There is certainly much need for the work which is being taken up by the Association of Car-Lighting Engineers, which held its first convention in Chicago last week. The chaotic condition of train lighting practice was well illustrated by the author of one of the papers, who said that in the 28 years which have elapsed since the fundamental principles of the axle lighting system were first propounded, "axle light apparatus has not become as standard as automobiles, although it is probably more standardized than flying machines." The report of the lamp committee further illustrated the condition, for it appears that out of 16 large railway systems tabulated, only seven have adopted for their own individual use a single lamp voltage. Other roads have from two to five different voltages in use on cars, and the seven roads which individually have standardized to a single voltage do not agree between themselves, having voltages all the way from 30 to 110. Electric train lighting practice is, in fact, as mixed as was the mechanical practice of railroads in the early days before M. C. B. standards were known. That such a confused state of affairs has grown up in an industry which interchanges rolling stock as do steam railroads, and in which standardization of practice and parts is practised so extensively, is perhaps largely because electric train lighting has not been taken seriously enough by the higher officials of our railroads, being looked upon as a very small part in a big machine. To judge from facts brought out at the convention, United States practice is considerably behind that of England and the Continent, and one reason for this appears to be that sufficient attention has not been given here to training experts in the maintenance of equipment. That expert care and attention are necessary for electric train lighting apparatus be-

came early evident in England, and steps were taken to train and educate men for the work. In this country apparently more reliance has been placed on making apparatus as "foolproof" as possible and then turning it loose on the tender mercies of porters and train crews.

Not the least interesting part of the convention was the extended discussion given to the question of equipping cars exclusively for electric light and providing no other auxiliary save candles. It was almost unanimously agreed that an electric lighting system properly maintained is reliable enough to dispense with the expense of an auxiliary system. In fact, a large percentage of the failures of electric light was shown to be not inherent in the system, but due to the failure of locomotives to supply steam or something of that nature. It was pointed out that the present neglect of electric lighting equipment which now exists would disappear were absolute dependence placed on electric lighting. The presence of an auxiliary system invites neglect of the electric lighting system and also invites waste, as train crews sometimes have both systems going at once. That there is much in the contention that absolute dependence on the electric system forces the railway organization to pay better attention to its maintenance, is indicated by the 30,000 cars stated to be in operation in England and other foreign countries with axle-driven equipment from the factory of one concern alone, in all of which cars entire dependence is placed on the electric light. The Association of Car-Lighting Engineers has a large task before it in standardizing equipment to facilitate the interchange of passenger cars from one road to another, and also in getting the train lighting part of steam railroad operation on a more satisfactory engineering basis. In this work they will have the good wishes of all electrical people, and should receive the encouragement of the railroad companies.

Station Efficiencies.

We note in the Digest an interesting contribution by Mr. H. M. Hobart to the broad theory of efficiencies, which reduces the problem of station efficiency to extremely simple terms. Assuming as unity, or as constants, the efficiency of the steam production up to the prime movers and the generator efficiency, then the obtainable efficiency becomes a function of two temperatures, those of the feed water and the steam of the prime mover, and two pressures of the steam and the condenser, respectively. Such simple conditions obviously can be readily applied only to stations big enough to keep the load factor practically constant by switching on the number of units really needed—in other words, taking the peaks at constant efficiency. Mr. Hobart actually assumes perfect boiler and generator set efficiency, but, of course, for the condition of constant efficiency only a simple conversion factor need be taken into account to obtain the net thermodynamic efficiency for any given assumption as to the values of the four quantities given.

Mr. Hobart confines his tabulated results to data well within the range of practice, taking pressures of steam of approximately 85 lb., 128 lb. and 170 lb. per square inch at 0 deg. and 100 deg. C. superheat and at condenser pressures easily improved. Running over his results we find for 170 lb. steam at 100 deg. C. supertemperature and a condenser pressure of 1.4 lb. per square inch, a gross over-all efficiency of 28.4 per cent. Taking a first-class boiler and generating set full load efficiencies, this amounts net to about 14 per cent efficiency from coal pile to busbar. As Mr. Hobart notes, this efficiency is reduced for average load conditions to a serious extent, so that over 10 per cent net efficiency has very rarely been recorded and 8 per cent is a very creditable figure. Indeed it is, and most stations do not come anywhere near it in all-the-year-round practice. Under the conditions stated as to temperatures and pressures, the energy which is non-convertible and must be passed from the condenser unused is 70 per cent of the whole. Morally speaking, this cannot be charged to imperfections in apparatus, but must be laid to the discredit of our necessary environment. Both boilers and engines are really much better than the commonly received figures indicate upon their faces. Undoubtedly there can be material improvement made in pressure and superheat, but the fact is that the biggest loss of efficiency may generally be sought in the boiler room. A good deal of attention has of late been paid to this side of the question, yet the fact remains that the evaporation actually attained per pound of coal is a long ways from what a properly fired boiler can be made to give under test. The furnace never seems to come quite up to the mark continuously and the boilers get out of condition, and then the efficiency has fallen off and the costs run up.

We have sometimes wondered whether it would not pay a great station to keep on regular duty in the boiler room a first-class expert such as the boilermakers put in charge of their tests, or express steamers and warships have in charge of fire-room watches, driving things up to the mark. There are some pretty good men in service now, but if a boiler can be made to evaporate 10 (or more) lb. of water per pound of coal on a 24-hour test, why should it fall to 9 lb. or 8 lb. on the year's run. It would be worth while to gamble 10 per cent of the coal bill for the sake of finding out. It certainly should be possible to get some information of great pecuniary value by digging away at the problem for a while. The over-all efficiency of the ordinary big station is assuredly capable of great improvement. If 10 per cent efficiency is attainable, then it should be attained or someone should find out definitely the reason why. Every step upward in the over-all efficiency means a chance for more economical supply and a larger market. With the coming of very large stations distributing power on a huge scale and by the most economical methods, it should be possible to make electrical supply a necessity and not, as it now is in many instances, rather a luxury. Consolidation of supply systems is a good sign, and if conservatively carried out so as not unduly to increase the fixed charges, it is the best possible thing for the community. Competition among small stations never brings down prices like a judicious consolidation with its attendant economies. Electric light ought to be a necessity not to be dispensed with, and the day is near when it will be so reckoned. To reach this point it is not only necessary to keep down the generating cost, but to improve the distribution and the general costs of conducting the clerical cost of the business as a business. Stations often complain that small users do not pay when the real trouble is that the particular business concerned has been organized with special reference to the large consumer and the same mechanism is not equally well suited to the small one. Efficient generation is the first step, efficient distribution is the next, but efficient organization is a necessary staff along the way.

IRON LOSSES OF POWER IN ASYNCHRONOUS MOTORS.

As noted in the Digest this week, the *Elektrotechnische Zeitschrift* has recently published an article by O. S. Bragstad and A. Fraenckel on certain additional power losses that occur in the teeth of induction motors. The iron losses produced in these machines are of two kinds—first, those which are due to the cyclic magnetic flux density in the rotation of the magnetic field; and, second, those due to the much more rapid fluctuations of flux density caused by the passage of the teeth. It is this second kind of loss to which the article calls particular attention. The article shows that the extra iron losses follow a different law in magnitude from that obeyed by the ordinary iron losses. They increase in proportion to the square of the flux density and as the 1.5th power of the speed of rotation. The iron losses due to tooth pulsation are apt to be exaggerated in induction motors, as compared with direct-current machines, owing to the very small clearances with which induction motors usually operate. If direct-current machines operated with a clearance of only 1 mm instead of with 4 mm or 5 mm, the pole iron losses due to the armature teeth action would be markedly increased. The article is accompanied by oscillographs which show very clearly the marked influence of tooth action upon the magnetization of the machine tested. This is another illustration of the practical value of the oscillograph in analyzing the actions which occur in alternating-current machinery. Before the days of the oscillograph, magnetic exploration was of the statical, rather than of the kinematical, type and much greater difficulty was experienced in obtaining experimental evidence of rapidly fluctuating electromagnetic actions.

COMPLEX HARMONIC ALTERNATING CURRENTS.

There are certain outlines, curves and displacements that are found very frequently in Nature, and others which, on the contrary, are rare, as though they were out of conformity with the established order of things. The form and movement which are pre-eminently favorites in the natural world are sinusoidal. We have the sinusoidal outline as the essential form of the ocean wave. The sinusoidal movement is typically presented in sound waves, light waves, wireless-telegraph waves, long-pendulum swings, mechanical vibrations of all kinds, molecular motions, planetary motions. No matter how complicated any one of these various movements may be, we find that the total motion may be analyzed into a number of component sinusoidal motions, and that the simplest kind of any one motion is the simple sinusoidal motion. Why the sinusoidal forms, displacements and movements should be so fashionable in the natural world, when forms, displacements and movements of a seemingly simpler character, such as the plain zigzag, are conspicuous by their absence, is a question that touches the borderland of metaphysics. However, there are two plain causes that suggest themselves to plain reasoning. One is that the sinusoidal motion is intimately connected with motion in a circle, the simplest two-dimensional figure, because two equal sinusoidal or harmonic motions, acting in quadrature, are equivalent to a simple circular motion. A sinusoidal or harmonic motion is, in this sense, half of a circular motion, or is a circular motion projected on a line. Secondly, of all types of motions that we can conceive of, the sinusoidal is effected with the least average variation, or disturbance. Zigzag movements involve discontinuities at their extremities, with violent changes of force and of energy. They shake things up badly. Sinusoidal movements avoid discontinuities and involve minimum disturbance. A world of sinusoidal movements is essentially an evolutionary world, whereas a world of zigzag or sharp-peak wave movements would be essentially a revolutionary world. In alternating-current circuits we have the same conditions. Rectangular waves of current, or zigzag waves of current, are easier to draw on paper than sinusoidal waves, but nature prefers the sinusoidal, and the simplest kind of alternating-current wave is the simple harmonic, or sinusoidal wave, resembling in form the wave of ocean swell. In practice, we rarely find the simple sinusoidal wave-form when we use the oscillograph, and photograph the waves. But even with the most complicated waves we find it helpful to consider them as equivalent to the combination of a number of individual wave-trains of frequencies in simple numerical relation; that is, to look upon them as complex harmonics. Engineers are accustomed to treat such complex waves as substitutes for an equivalent sinusoidal wave, which would give the same readings on the voltmeter, ammeter and wattmeter as the actual complex harmonic wave.

Prof. Benj. F. Bailey, in his article on page 1179 this week, calls attention to some features of complex harmonic e.m.fs. and currents. He shows that if the e.m.f. waves generated by the alternator in a central station and by a synchronous motor operated on its system are very different, it is generally impossible to obtain a high power factor for the motor by adjusting its excitation. There will be cross-currents between generator and motor which will be equivalent to wattless currents in the simple case of sinusoidal motor and generator e.m.fs. Only when the motor and generator e.m.f. waves have the same shape is it reasonable to expect that the motor power factor can be brought close to 100 per cent by adjusting the motor field excitation. This condition of affairs indicates a defect in the ordinary switchboard power-factor meter, which tends to show 100 per cent power factor when the phases of generator e.m.f. and motor c.e.m.f. coincide, without regard to cross-currents in the cycle due to differences of wave shape. On the other hand, however, a true power-factor indicator would lose one of the advantages of the ordinary switchboard instrument, i. e., isachronism indication, or coincidence-of-phase indication. Another interesting point brought out in the article is that a sinusoidal e.m.f. wave may be more easily produced in a six-phase, double-delta converter than in a three-phase diametrical converter, and that the most difficult type to sinusoid is the ordinary three-phase delta converter.

It is not difficult to design alternators that shall produce a close approximation to a sine wave of e.m.f. at no-load. That is, it is not difficult to sinusoid the e.m.f. of an alternator in course of design, when the operation of the machine is considered on open circuit, but it is almost impossible to keep the e.m.f. wave-form of an alternator sinusoidal under load, owing to armature reaction. Harmonics, or high-frequency ripples, spring into existence as the load comes on the machine. It is quite conceivable, however, that the alternator of the future may be substantially free from the effects of armature reaction, and that such a machine may give a sinusoidal e.m.f. wave at all loads. Such machines would then tend to supply sinusoidal current waves to their distributing systems, except for the hysteretic effects of magnetic waste in iron and electric waste in dielectrics.

Westinghouse Readjustment Plan Adopted.

The readjustment committee of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., announced Nov. 20 that the modified or substitute plan for the readjustment of the debt of the company had been declared operative. This means that the final stage in the rehabilitation of the company has been reached and that in all probability the company will be out of the hands of the receivers and turned over to the stockholders very soon.

The readjustment committee went into session on Nov. 17. The reports submitted by the other committees, notably the merchandise creditors' committee, the stockholders' committee and the employees' committee were considered, and conclusions formed from the facts as presented to the readjustment committee. Mr. J. N. Jarvie, chairman of the readjustment committee, made the following statement on Nov. 20:

"The readjustment committee of the Westinghouse Electric & Manufacturing Company has declared the plan for the rehabilitation of the company's affairs operative."

Mr. Paul D. Cravath, counsel for the company, issued the following statement:

"As announced by Mr. Jarvie, the readjustment committee has declared operative the modified or substitute plan for the readjustment of the company, which plan is based upon the so-called merchandise creditors' plan. Counsel will now go ahead with the necessary proceedings for the termination of the receivership, the issue of the new securities and the restoration of the business of the company, all of which will be accomplished in the near future. The stockholders' meeting for the election of the new board of directors and other actions required in the consummation of the plan will be held in East Pittsburgh Nov. 24."

It is unofficially stated that Mr. George Westinghouse will remain as president of the company, and that the directors will be: Mr. James S. Kuhn, president of the First National Bank, Pittsburgh; Mr. Joseph W. Marsh, vice-president and general manager of the Standard Underground Cable Company; Mr. Richard Delafield, president of the National Park Bank, New York; Mr. Albert Wiggin, vice-president of the Chase National Bank, New York; Mr. William McConway, president of the McConway & Torley Company, and a director of several Pittsburgh banks; Mr. A. N. Brooker, president of the Ansonia Copper Company; Mr. A. G. Becker, Chicago; Mr. Neil Rantoul, of F. S. Moseley & Company, Boston; Mr. George Westinghouse; Mr. E. M. Herr, vice-president of the Westinghouse Electric & Manufacturing Company; Mr. Stuart Brown, Pittsburgh; Mr. E. C. Converse, New York; Mr. Anthony N. Brady, New York, and Mr. George Verity, president of the Middleton Iron & Steel Company.

While the merchandise creditors agreed to accept new stock in the company in payment of their $4,000,000 of claims, the stockholders contribute $6,000,000 of new capital by subscribing that amount of stock at par. The employees, besides making their contributions as stockholders, accepted salary cuts ranging from 20 per cent to 7½ per cent. The company has been making money steadily since the receivership, and the profits realized are now $9,000,000. This, with the $6,000,000 cash supplied by the stock subscriptions, gives the company $15,000,000 cash working capital in addition to which $6,000,000 debts have been funded. The total liabilities consisted of about $29,000,000 funded debt and about $15,000,000 floating debt.

Connecticut Public Service Commission.

The establishment of a public service commission for Connecticut is favored in a report of the special committee appointed at the last Legislature to investigate the question of the appointment of such a commission. It is proposed that this commission shall consist of three members, to be named by the governor and confirmed by the concurrent action of both branches of the general assembly. The salaries are fixed at $7,500 a year each. Commissioners can be removed by the Superior Court on written complaint by the attorney-general, after a hearing. No employee, stockholder or agent of any company shall be eligible for a commissionership. The duties are generally defined in the report as follows:

"The commission shall have the general supervision of all railroads, street railways, gas, electric, water, express, telephone and telegraph companies, in so far as they are subject to State control, and shall keep itself fully informed as to the compliance with law by said companies, and when deemed necessary, shall report violations of the law to proper officials having jurisdiction of such violations."

Bell vs. Independent Telephone Litigation.

Judge Tayler, of the United States Circuit Court, at Cleveland, Ohio, has granted a temporary injunction against the American Telephone & Telegraph Company (Bell parent system) and the Central Union Telephone Company (Bell company operating in Ohio, Indiana and Illinois) restraining them from interfering with the business of the independent companies operating in those and adjoining States. The injunction was granted at Cleveland upon the application of officers of the United States Telephone Company, which is the independent long-distance telephone company operating in Ohio and adjoining States.

It is charged that the Bell company is pursuing the policy of absorbing independent companies so as to eliminate competition. This is said to be in violation not only of the Sherman anti-trust law, but also of the laws of Ohio, Indiana, Illinois and other States in which the companies operate.

The bill of complaint asserts that the defendants in an effort to regain the monopoly in the above-mentioned territory have been in the last year inducing the independent companies to violate their contracts with the complainant and to make connections with the Bell system for the transmission of toll messages. It is alleged that the American Telephone & Telegraph Company owns more than three-quarters of the Central Union's stock and is directing its policy.

The complainant gave a list of nine independent companies which it says have been induced by the defendants to break their contractual relations with the complainant. It is declared that the company is still making inducements to other companies by offering to purchase stock and give preferential rates or by merger of properties or division of territory in such manner as to prevent competition.

Transfer of Lighting Companies in New England.

Colonel F. S. Richardson, of North Adams, Mass., has transferred his controlling interests in the North Adams, Adams, Williamstown and Stamford lighting companies to the Massachusetts Lighting Companies of Boston, of which Arthur E. Childs, Esq., is president. The new control will be assumed not later than Dec. 15. The capitalization is as follows: North Adams, $200,000; Adams, $60,000; Williamstown, $40,000, and Stamford, $2,000. It is expected that practically all the stockholders in these companies who received the same offer that was given to Colonel Richardson, will dispose of their holdings. The Massachusetts Company announces that there is to be no change in the policy of the concerns acquired.

Colonel Richardson has been interested in these companies for about 30 years and has built them up from gross earnings of $20,000 per year to over $275,000. He will continue his residence in North Adams, but will not engage in business. It is probable that the four companies controlled by the new interest will be consolidated. It is not expected that the transfer of the business to a new company will affect the recent plans for a new central station at North Adams.

Important High-Speed Electric Railway Decision in Massachusetts.

A decision of much importance to the future of high-speed electric railroading in Massachusetts was issued on Nov. 17 by the Railroad Commission of that State in connection with the petition of the Boston & Eastern Electric Railroad Company for a certificate of exigency stating that public convenience and necessity require the building of its line. The plans of this company as prepared and presented by its chief engineer, Mr. J. H. Bickford, of Boston, have been the subject of investigations and hearings extending over the past two years, and the case has attracted more attention in Eastern Massachusetts than any other interurban electric railway project ever brought before the commission. From the first the plans of the new company were vigorously opposed by the existing transportation interests in the territory north of Boston, and thousands of pages of expert testimony and arguments have been required to record the progress of the matter. The board now states that public convenience and necessity have been demonstrated for this project, but a certificate is withheld at the agreement of all parties pending the securing of legislative permission to build a tunnel under Boston harbor and a short subway from the water front to the central business district.

The probabilities are that in view of the recommendations of the commission, legislative authority will be granted in the near future for the building of the tunnel and subway links of the road. The company plans to construct a high-speed interurban railroad of the most advanced type between the cities of Boston, Lynn and Salem, connecting with Beverly and Danvers, the line to be entirely on a private right of way, and adapted to fast running. The estimated cost is about $11,000,000. The plans call for station platforms on a level with the car doors, double-track construction throughout, no grade crossings, multiple unit trains with fireproof cars, four-motor, 600-volt, direct-current equipments, block signals, and a running time of about 20 minutes between Boston and Salem. The equipment of the road will include 90-lb. rails, 20 stations, an 8000-kw power plant, three substations aggregating 10,000 kw, 50 cars each with four 200-hp motors, service cars, shops, and third-rail distribution system, with transmission line feeding the substations. The estimated cost of the power plant, on the basis of 8000 kw, is as follows:

Land, wharf, etc., $4 per kilowatt	$32,000
Building, foundations, stack, intake, $20 per kilowatt	160,000
Boilers, stokers, piping, engines, generators, auxiliaries at $62 per kilowatt	496,000
Electrical equipment, except generators, $4 per kilowatt	32,000
Miscellaneous allowance of 10 per cent, $10 per kilowatt	80,000
Total	$800,000

The estimated cost of the distributing system is as follows:

Third rail installed, 41.3 miles, at $4,700 per mile	$194,100
Bonding track, 41.3 miles, at $500 per mile	20,650
Transmission cable, 7 miles, at $7,920 per mile	55,340
Transmission line, 16 miles, at $4,000 per mile	64,000
Terminal houses, two at $3,000	6,000
Total	$340,090

Substations are figured at $30 per kilowatt, and cars at $16,850 each. The proposed tunnel and subway are figured at a total cost of $2,190,060.

Suit by New York Public Service Commission to Recover for Non-Compliance with Its Order.

The Public Service Commission of the Second District of New York has brought an action in the Supreme Court to recover $47,000 as penalty for the failure of the Port Jarvis Electric Light, Gas, Power & Railroad Company, Port Jervis, N. Y., to comply with the order of the commission made on May 12, 1908, requiring that certain physical improvements be made to the property. The company has filed an answer in which it admits its non-complance with the commission's order, but states that it was without resources to carry out the work, that pending proceedings with the Public Service Commission an application was made for permission to abandon its Kingston Avenue branch, and that a hearing took place on the matter on July 2, 1908, at which the company stated that it had not raised the money to comply with the order of May 12.

Tree Trimming for Wires in the South.

Mr. A. J. Sproles, the superintendent of the Greenwood municipal water and electric light plant, Greenwood, S. C., has noted with much interest the recent articles and communications in this journal on the subject of tree trimming as related to poles and wires. He furnishes us with data given below as to the treatment of water oaks in and around Greenwood:

"While my opportunities and experiences along these lines are limited and circumscribed, I am in full sympathy and accord with the widespread movement for 'Civic Beauty,' and keep 'an eye single to it' in every department of our work, whether in setting poles, stringing wires on the streets or entering premises, hanging lamps or pruning trees. The latter has given me more concern and 'troubles within and without' than all the others combined, which, I dare say, is the experience of many other superintendents.

"Our shade trees are, mainly, water oaks, and, if not disturbed, grow vigorously and with great beauty and symmetry, but by injudicious pruning they may be made very unsightly, against which our citizens have always rebeled and risen up in arms, and I don't blame them.

"To avoid unnecessary trimming and incident mutilation, where possible we dodge the trees, believing a crooked line more sightly than a mutilated tree, but when we must pass through or over them, we bracket the largest limbs of the larger trees and cut the tops smooth across the smaller ones when they reach our wires, allowing the side branches to grow up and overlap our wires; after which, we only keep the twigs cut from the circle thus formed, which will not show much from the street and still afford abundant shade. However, we only have seven wires and 2300 volts. We have not followed this plan long enough to be positive of results, but it promises well.

"Then too—while not a forester—I find this plan works well in that it is carried out under my personal supervision, and while it is being done I entertain the nearby and irate citizens by entering into sympathy with them, telling them my plan in detail, how the current will kill the tree if left in contact, how its branches cut off light and all the other reasons I can think of why they have to be pruned—with the never-failing result that it pacifies, allays anger and saves friction, even if it does not help the trees. I find it is well to have a plan for doing everything, and where the public is so vitally concerned to let the people know it in detail."

Prices of Tungsten Lamps Reduced by Boston Edison Company.

The Edison Electric Illuminating Company of Boston has reduced the prices of tungsten lamps from $1 to 75 cents in the 32-cp size; from $1.10 to 90 cents in the 50-cp units, and from $1.25 to $1.10 in the 80-cp size. About Nov. 1 the company began to supply 20-cp tungstens at a cost of 60 cents each, and has now secured orders for upward of 10,000 of these lamps. Except in new installations the company requires that old lamps be given in exchange to secure these prices. With the tungsten lamps at the lowered cost, the smaller candle-power lamps now available, and the reduction of rates from 15 cents to 12 cents per kw-hour, the company is supplying light at half the cost of a year ago to its customers, and is giving the gas interests the sharpest kind of competition. About 90 per cent of the customers of the company who are using high candle-power lamps have equipped themselves with the tungsten units. Just before the announcement was made that the company would supply 25-cp tungsten lamps, a letter was sent to every customer informing him of the opportunity to file his request for these lamps before customers about to be taken on were supplied. The response has been very gratifying.

Investigation of New York City Central Station Companies.

Hearings in the investigation regarding electrical supply companies which is being conducted by the New York Public Service Commission of the First District were held before Commissioner Maltbie on Nov. 13. Hearings were held in two investigations: (1) For the purpose of determining whether, in order to prevent discrimination and unreasonable preference by central-station companies, an order should be issued by the commission containing the provisions against discrimination and unreasonable preferences, embodied in a draft of order No. 822 submitted to the companies; (2) to determine whether, in order to secure uniform and adequate dissemination of information as to the rates, contracts and practices relating to service furnished by central stations, and to prevent discrimination and unreasonable preference, and also deviation from their rates, an order should be issued by the commission containing provisions in regard to the publication of rates and deviation therefrom, embodied in a draft of order No. 823 submitted to the companies.

Commissioner Maltbie, in opening the hearing, said he had received a telephone message from the Richmond Light & Railroad Company stating that it had no objection to the issuance of either order. He would like to hear suggestions regarding the first subject outlined from those present.

Mr. J. W. Lieb, Jr., associate general manager, New York Edison Company, said that company had no objection to the issuance of order No. 822, the first subject outlined. The company had been and is in entire sympathy with the order covering broadly the subject of discrimination. One or two questions had arisen in connection with the order, involving interpretation of various features. The general features of the clause might appear to prohibit the special rates that were accorded to the City of New York under legislative enactments. Mr. Lieb had in mind not only the street service, but also individual public buildings. Commissioner Maltbie said it was not intended to interfere with the present arrangement with the city.

Mr. F. W. Smith, secretary, United Electric Light & Power Company, said that that company saw no objection to the issuance of order No. 822. It believed that it was carrying out the requirements of the order at the present time.

Mr. Carleton Macy, Queens Borough Gas & Electric Company, said that that company had no objection to the order beyond the fact that it had two or three, or possibly four, old contracts, which had been taken over by the company, but had not yet expired and could not be canceled at the present time. One had three years to run. Commissioner Maltbie asked whether the contracts had any termination clause and if the question had ever been considered that if the contracts are discriminatory they might not have been entered into legally. Mr. Macy said he thought that aspect of the question had not been considered. Commissioner Maltbie said that if the contract had been made properly and it could not be set aside, the questions that would develop would be interesting because, of course, the commission could make no order which would interfere with a contract that was legal and binding in every other way and authorized by the statute. Mr. Macy having stated that the company would like to get rid of the contracts, Commissioner Maltbie said he presumed a lawyer would probably find a way of releasing the company from its difficulties.

Mr. W. W. Freeman, Edison Electric Illuminating Company of Brooklyn, said that that company took no exception whatever to the requirement for uniformity of charges. This requirement followed out the plans for procedure of the company. He did not want to commit himself to approval of the exact wording of the proposed order. It seemed to him that the exact verbiage might be involved. It was stated that the language of certain sections had been modeled very closely after the Interstate Commerce act. Commissioner Maltbie said there might be some changes which ought to be made, although the commission followed the language of the Interstate Commerce act where it could. He supposed that was the reason why the use of the word "traffic" had been adopted when the word "business" or some other word would have described the situation more accurately.

The hearing on the form of the other order was then taken up. Commissioner Maltbie said he desired, if possible, to have this order take effect Jan. 1.

Mr. Lieb thought that the order contained a number of provisions that should be given much more careful consideration than had been possible in the limited time allowed. A number of questions involved in the order had been referred to counsel for the purpose of learning what their interpretation would be, and their replies or advice had not been received. While at this time the company did not make formal objection to the issuance of the order as a whole, it urged that further time be given for the consideration of some of the important provisions. Mr. Lieb then made some detailed criticisms of the form of the order.

Mr. Freeman asked whether it was the thought of the commission that it was possible to include in the schedule every detail of regulation so that it would be impossible, in compliance with the order, to make any modification in the verbiage of a contract that would have no effect on the rate or the character of the contract, but would simply give some special condition. If that was the case, he would like to go on record as saying that, in his opinion, it was absolutely impracticable to have such a method of procedure.

Commissioner Maltbie said the idea was to have the relations with the consumers standardized and published and posted, so that every consumer who met the conditions was treated in the same way, and knew it. There were probably cases where a question could be dealt with in a moment, where something new might be devised, but if that was of sufficient importance to cause a ruling and regulation of the company there was no reason, that he could see, why it should not be included in the schedule and made known to every consumer.

Mr. Lieb said that when a contract was made with a large consumer, for instance, he might say he would like to have his meters read once a week. Commissioner Maltbie said that all the company would have to do in its schedule was to indicate that the meter could be read weekly or monthly, or weekly under certain conditions, or monthly under certain conditions. To put in the schedule a contract which provided for monthly readings, and allow the company to cross that off with a pen and put in "weekly readings" would modify it in a specific sense and would violate a fundamental principle.

Mr. Lieb suggested that in some of the contracts for wholesale supply the company had a provision for the sale of lamps at a certain price. If the company should add "the lamps so supplied will be the best lamps that are in the market," it would have no bearing on the compensation and would not be discriminatory in the general sense of the term. Commissioner Maltbie asked if the door were opened where the practice would end. Mr. Lieb thought that the company would not be allowed to go very far before it would be asked by the commission to justify any such clause and to show whether it could be distorted into a medium of discrimination.

Commissioner Maltbie thought that the clause might amount to nothing, but a large number of people could not be convinced of that fact. He thought that if a man was allowed to have trivial changes he would apply for a substantial change, but if he was told in the beginning that the contract could not be changed for the special benefit of one unless it was changed for the benefit of all, contests for trivial changes would be ended to a certain extent. If the company should include in a contract that the connections of the consumer are such that the current supply would be served from two or more stations, Commissioner Maltbie thought that would constitute an advantage.

Mr. Freeman said it seemed to him that the subject was more fundamental than was appreciated. The desire of the commission in the matter, as he took it, was to prevent unjust and

unreasonable discrimination. The willingness of the public service corporations in that respect was no less sincere and acute than the desire of the commission. What the public wanted in a schedule of this kind was the ability to ascertain, without undue difficulty, what are the rates and the general regulations of the public service corporations. If this schedule should be lumbered up by technicalities and trivialities, the voluminousness would tend very largely to defeat the purpose of it. He would like to put before the commission as emphatically as he could the conviction that it would be impossible to place the public service corporations upon the basis of an automatic machine, where the customer could come and press a button and get automatically what he desired without the exercise of any business discretion or any merchandising sense on the part of the corporation. He took it that the Public Service Commission was here to stay, and its supervision would consist not only in signing an order that would meet all provisions for all time to come, but also in a general supervision of the business of the corporations. It seemed to him very important that any proceedings of this kind should show what it was desired to show, and should open the door for further supervision through the consideration of complaints, the investigation of the complaints and the determination if any discrimination existed. He wanted, however, to protest as strongly as he could against the introduction into the schedule or the attempt to introduce into it every detail and every item of change necessary to meet every varying condition of 150,000 consumers in New York City. From his experience he regarded that as an absolute impossibility and the attempt to accomplish that purpose, though well meant, would in effect defeat the real purpose that those who were present had gathered to meet.

In answer to the inquiry as to where to close the door if it was opened, Mr. Freeman suggested that the difficulty of a proposition was no reason why one should be unwilling to meet it. He did not believe the commission could, in its judgment, bring about the execution of a plan such as was contemplated, if he understood it. He believed that the commission would limit the order to the vital points of the contract and to the system of doing business, and leave to the companies some reasonable judgment, some reasonable merchandising possibilities that would enable them to meet their customers upon a business basis. Mr. Freeman said that one of the serious complaints against public service corporations was their independence toward their customers. If a customer was handed an iron-clad form and told to take or leave it, that would create an unpleasant impression in his mind. The ability of the public service corporation to explain the meaning of its contracts and make the meaning even clearer than it might be to the applicants by changing a word here and there that did not alter the purpose or intent of the contract, was a very valuable asset to the company. With the constant supervision of the commission it would have the ability to correct any abuse that might arise from time to time, and it ought not to undertake anything which in the opinion of the public service corporation itself would tend to hamstring the latter in its business operations. Mr. Freeman was not opposing the plan in general; he was a hearty advocate of it and was not opposing the object in mind.

Mr. Lieb spoke of the people who in their negotiations with the company raised what seemed to be entirely trivial questions to the company, but in the minds of the customers were magnified to importance. The question of two or three service connections came up, and representatives of the companies pointed out that they could frequently give connections of this character because of the location of streets. In such cases owners of buildings sometimes wanted the fact included in the contracts.

Discussing the subject, Mr. Arthur Williams, general inspector, New York Edison Company, suggested that the line could be drawn where any clause or rider modified the final cost of the service to the consumer. Mr. Smith pointed out occasions where trivial changes were requested.

Commissioner Maltbie said that as far as the order went the companies could have as many forms of contracts as they desired; there would be nothing in the order to limit the number. If the company prepared a form of contract and instead of having it reprinted into five or six forms, wanted to attach to one form any one of five riders, all that would be needed was to say that the applicant could have any or all of the riders attached to the form of contract. The riders would be printed after the schedule and filed with it.

Fremont Wilson, consulting engineer, said he hoped that a form would be adopted that would do away with the fine print on the back of a contract. From an engineering standpoint, and also from a fire insurance standpoint, as well as from the point of view of the consumer, it was sometimes advisable as well as feasible to connect more than one service into a building. The desirability of getting more than one service, from a fire insurance standpoint, was not a small one. The endeavor was to eliminate isolated plants wherever it could be done without hardship to the person owning or operating the building. He did not care how carefully every isolated plant was operated, it was a fire hazard.

The hearing was then adjourned to Nov. 24.

Great Falls Water Power Development.

Work is advancing rapidly in connection with the 60,000-hp development on the upper Missouri River in the vicinity of Great Falls, Mont. The diverting coffer dam at Rainbow Falls has been completed so that the engineering force can get into the bed of the river to make its surveys for the power house and headworks. This dam is built of stone and dirt and is not intended to be absolutely tight. A second coffer dam will be built later which will be permanent, and inside of which the actual construction work will be done. The plans for the dam and masonry work at the head gates are now complete. Those for the power station and machinery contained therein will be made later at the Boston office of Mr. Charles T. Main, the engineer in charge of development.

An engineering building has been constructed for the engineering force, containing a drawing room, living room, sleeping rooms and bath room. This building will be steam heated and electrically lighted from a temporary plant. A spur track from the Great Northern Railroad has been built into this plant for a distance of 3000 ft. and is ready for use. On account of the bed of the river being of sandstone, the type of dam which has been designed is a rock-filled crib, covering a large area of the bed with a very large apron. The lumber for the dam has been ordered.

At the Great Falls of the Missouri the program is practically the same as that at Rainbow Falls. The diverting dam is partially built and the surveys in the bed of the river are being made. It is expected that this work will be carried out at the same time as that at Rainbow Falls, but that it will not be pushed to the same extent as that at the upper development.

No contracts will be let for the construction work of the dams or power houses, as the Townsite Company is doing this work, with its own superintendent.

Ellsworth, Maine, Hydro-Electric Plant.

The Bar Harbor & Union River Power Company is now supplying power to Charleston and Northeast Harbor, Maine, from its hydro-electric generating plant at Ellsworth. The load at Northeast Harbor is mainly lighting service. The line between the towns of Charleston and Northeast Harbor is about 100 miles in length. The Bangor load now raises the station output at Ellsworth to 1500 hp. A line for lighting service is projected for the supply of Franklin, Sullivan and Sorrento. If the load continues to increase at the present rate the present power house installation will have to be enlarged and the storage dam originally planned will have to be constructed.

Convention of Association of Car-Lighting Engineers.

The Association of Car Lighting Engineers, consisting of electrical engineers of steam railroads and others interested in the electric lighting of steam railroad trains, met in convention at the Grand Pacific Hotel, Chicago, Nov. 16 to 19. This association, which was organized last summer, has for its object the exchange of ideas on electric train lighting and the standardization of practice in train lighting in order to facilitate interchange of cars.

At the first session, held Monday morning, Nov. 16, President A. J. Farrelly, electrical engineer of the Chicago & Northwestern Railway, gave a short account of the reasons and events leading up to the organization of the association. On May 20, 1908, 10 electrical engineers of steam railroads met at Ogden, Utah, for the purpose of taking up certain business questions in which their various railroad companies were concerned. At that time it was suggested that an association of electric train lighting engineers would be desirable on account of the chaotic condition of electric train lighting in the United States and the desirability of bringing this branch of railroad work into greater prominence so that it will receive the attention it deserves. Following this a meeting was held in August, 1908, at the Grand Pacific Hotel, Chicago, at which 40 charter members met and organized the Association of Car Lighting Engineers.

The opening papers of the convention were mainly historical. The first was a paper on "The History of Railway and Electric Train Lighting," by a committee consisting of Messrs. Patrick Kennedy, Morris Moskowitz and Wm. F. Bauer. This was followed with a paper on "The History of Axle Lighting," by Mr. W. L. Bliss. The paper went into the history of this subject very thoroughly in its personal, corporation, technical and patent aspects. As to the technical record of axle lighting, Mr. Bliss prefaced his remarks by referring to the essential elements of an axle-lighting system, as consisting of a revolving axle, a generator driven thereby, a set of storage batteries and some incandescent lamps. This sounds very simple and easy of application, but 28 years have elapsed since this proposition was first propounded. "In all that time axle-lighting apparatus has not become as standard as automobiles, although it is probably more standardized than flying machines." This statement, while merely indicating the chaotic state of the axle-lighting business, serves to emphasize the necessity for an association of steam railroad representatives engaged in this class of work. The historical series of papers with which the convention was opened was completed by the reading of a paper originally presented before a meeting of the American Institute of Electrical Engineers at Chicago, June 7, 1892, by Mr. A. H. Bauer.

Having thus gone over the previous history of train lighting, the convention proceeded to its work of discussing present practice and methods by taking up the report of its committee on the "Care and Maintenance of Storage Batteries." This report was read by Mr. F. R. Frost, chairman, electrical engineer of the Atchison, Topeka & Santa Fé Railroad, and its discussion for a time largely centered about the question of the relative merits of rubber jars as compared with lead-lined tanks. There was such a difference of opinion on this matter that at the opening session Tuesday morning resolutions were introduced to test the opinion of those present. A resolution that it was the sense of the meeting that reinforced rubber jars, properly set in petrolite or other suitable compound, are superior to lead-lined tanks received 11 affirmative and 12 negative votes.

The report of the committee on "Straight Electric Lighting" was then read by Mr. C. W. Bender, of the Pennsylvania Railroad, chairman. By the term "straight electric lighting" is meant the equipment of the car for electric lighting only, without any other auxiliary system other than candles for emergency use. This report did not favor the use of an auxiliary system. It is pointed out that with proper attention, the electric lighting system can be made as reliable as any other system, and that the use of an auxiliary system involves additional expense and is conducive to laxity in the maintenance of the electric system. Sometimes both systems are operated at once by train crews, which results in waste. Many cars have nothing but gas, and a failure of gas is more likely to last over long distances than is the failure of electric light. In the discussion which followed, all of the speakers, with one exception, favored the straight electric system without auxiliaries, and figures were given as to the small percentage of failures due to electrical causes.

Tuesday afternoon, by special invitation, Mr. W. E. Symons addressed the meeting relative to the possible growth of railway electric train lighting and the influence of electrification of steam railroads on train lighting. He read from a paper presented by him at the Western Society of Engineers, in which he made the point that with the electrification of steam railroad terminals and trunk lines there would come an extension of railroads into new territory, which would more than compensate for any reduction in number of steam locomotives needed for terminal and trunk line work. He predicted that in a few years 500,000 steam railroad passenger cars would have to be electrically lighted.

Mr. A. H. Darker, of J. Snow & Company, London, presented information on the electric lighting of railway trains in England, Germany, France, Canada and various other parts of the world. To judge from Mr. Darker's remarks, railway electric train lighting is on a much more satisfactory basis abroad than in the United States. The organization for maintaining train lighting seems to be more highly perfected, and electric lighting in much more general and satisfactory use than in the United States. He stated that his company alone, which is only one of those engaged in the business, has equipped 30,000 cars with an axle-driven system. A number of voltages are used—namely, 16, 24, 60 and 80. In England there is an association of 40 members, consisting of men who have in charge this kind of work. The expert services required are obtained by constant addition of young men to the ranks who are trained by being put through a good practical and technical training at the factory and in actual railway work. To show how completely the electric lighting of cars is depended upon, he said that his company had a standing offer of a hat to anyone who would show them a car equipped with the Snow system which had an auxiliary gas or oil lighting system. During the discussion on the difficulties experienced on American railroads in securing proper skilled and unskilled attendants for the maintenance of electric train lighting equipments, Mr. Darker said that in England the maintenance of these systems was at first placed in the hands of brakemen, with the usual discouraging results. The maintenance problem was only solved by the manufacturers taking up thoroughly the question of maintenance and expert men. The result is that a highly-perfected system has been evolved, and the old troubles have vanished. The cost of maintaining axle systems now runs from $25 to $40 per car per year. In England and on the Continent the electric-lighting equipment of the foreign car on a road is overhauled and repaired just as if the car belonged to the road. If the electrician of one road finds a foreign car with some part broken which must be supplied and has not such a part in stock, he telegraphs the electrician of the road owning the car for such a part and makes the repairs before the car is sent out. When an equipment has been overhauled, the date of the cleaning and examination is painted on the cover. When the time arrives for another cleaning, the electricians of the road where the car happens to be at the time take it in and overhaul it. In this way cars sometimes go for months in good condition without returning to the road which owns them. Batteries are overhauled thoroughly once a year. No cars on any of the large railroads are being equipped with other than electric light. The English Board of Trade does not approve of gas and recommends that electric lighting systems be used. In answer to a question as to voltage regulation, Mr. Darker replied that the voltage regulators of all of the manufacturers work well because they receive proper attention.

The committee on "Train Connectors" reported through its chairman, Mr. Frederick McGary. The report consisted mainly

of a brief enumeration and description of the principal connectors now used in train lighting. The discussion which followed showed a considerable variety of opinion as to the best practice in train connections.

The report of the committee on "Organization and Systematization in Connection with Electrically Lighted Trains" was made through its chairman, Mr. E. W. Jansen, chief electrician of the Illinois Central Railroad. This outlined the practice of a number of roads and naturally resulted in considerable discussion, as this matter is evidently in an unsatisfactory state on a great many railroads.

Wednesday morning the committee on "Head End Electric Lighting of Passenger Trains" reported through its chairman, Mr. C. R. Gilman, electrician of the Chicago, Milwaukee & St. Paul Railway. There was an extended discussion on this report, which took up the entire morning session. Wednesday afternoon the report of the committee on "Lamps" was read by Mr. J. M. Schilling. This report took up specially the question of tantalum and tungsten lamps, which are now available for train lighting, and showed the increased battery service to be obtained by the use of these lamps. Incidentally a table of considerable interest was given, showing the different voltages used on a number of roads and also the different systems. A number of roads had more than three voltages and several were operating cars with "head end," "straight storage" and "axle" lighting equipment. From the discussion it appears that a number of roads have availed themselves of tantalum lamps for car lighting, and some have begun to use tungsten lamps. Mr. Darker reported that two years ago in Belgium the tungsten lamp was adopted in a large number of cars and had since been adopted throughout. In England the tungsten lamp has been adopted as the standard, being operated at 16 volts and 24 volts, at a consumption of 1.5 watts per candle.

A paper on "Illumination and Distribution of Lights in Cars" was read by Mr. H. C. Meloy, chief electrician of the Lake Shore & Michigan Southern. This gave the results of a number of tests of illumination in railway cars.

Thursday morning the report of the committee on the "Straight Storage Battery System" was made by Mr. W. E. Ballentyne. After some discussion on this, the convention listened to the report of the committee on "Axle Lighting," of which Mr. A. Chester Terry, chief electrician of the Minneapolis, St. Paul & Sault Ste. Marie Railroad, was chairman. The discussion on axle-lighting equipment led up to a motion that a committee on standardization of car axles for axle-lighting equipment be appointed to confer with the Master Car Builders' Association and to endeavor to arrive at some standards for axles where axle-driven lighting equipment is to be used. It was pointed out that at present axle-lighting equipment sometimes has to be put on rough, hammered and tapered axles entirely unsuited to taking the driving pulley. This closed the last session of the convention devoted to such matters.

Thursday afternoon an executive session was held at which the following officers were elected for the ensuing year: President, Mr. A. J. Farrelly, Chicago & Northwestern Railway; first vice-president, Mr. A. J. Collett, Union Pacific Railway; second vice-president, Mr. C. R. Gilman, Chicago, Milwaukee & St. Paul Railway; third vice-president, Mr. G. W. Murray, San Pedro, Los Angeles & Salt Lake Railway; fourth vice-president, Mr. C. W. Bender, Pennsylvania Railroad; secretary and treasurer, Mr. G. B. Colegrove, Illinois Central Railroad. Executive committee: Messrs. D. J. Cartwright, Lehigh Valley Railroad; H. C. Meloy, Lake Shore & Michigan Southern Railway; A. C. Terry, Minneapolis, St. Paul & Sault Ste. Marie Railroad; G. W. Murray, San Pedro, Los Angeles & Salt Lake Railway; O. W. Ott, Oregon Short Line. Friday morning a number of members of the convention went to Milwaukee to visit electrical manufacturing establishments there. Wednesday night a banquest was held.

The 1909 convention will be held at Chicago, Oct. 5, 6, 7 and 8, 1909. On account of lack of space in this issue, only the report of the lamp committee can be abstracted. Abstracts of other papers will appear in following issues.

REPORT OF LAMP COMMITTEE.

This committee was instructed to gather information regarding present lamp practice in car lighting and the latest developments in incandescent lamps for this service. Investigation revealed that the various operating engineers while experiencing trouble with early burnouts, blackened globes, etc., had little definite idea of how these troubles could be overcome or of the relative merits of the different lamps. The manufacturers also had little information on car lighting lamps. It is claimed this has been due in a measure to the fact that the car lighting business has not been sufficient to warrant any particular manufacturer giving it much attention in view of the fact that there are now over 12 different voltages in use on various roads, and also a like variation in candle-powers. The tables submitted with the report show the most common voltages to be 30, 60 and 110. The manufacturers of lamps are anxious to bring about a standardization of car lighting lamps. To do this it would be necessary for the association to assist by arriving at some standard voltage and candle-power range in future practice.

The tables submitted with this report as to the carbon lamps manufactured for train lighting showed that round bulb lamps of 6 cp to 10 cp and straight-sided bulbs of 8 cp to 16 cp are available. The consumption of these lamps is from 3.5 watts to 3.1 watts per candle. These lamps have the standard Edison bases. There is one 8-cp lamp available for berth lighting having a bulb 1.5 in. in diameter to operate on 20 volts to 65 volts. This lamp is tipless, round-bulb, furnished with candelabra base.

The tungsten lamps at present available for train lighting are made for voltages from 20 to 32. The candle-power sizes are 8, 12, 16, 20, 24 and 48. The consumption is 1.25 watts per candle. Straight-sided bulbs are made in 8 cp, 12 cp, 16 cp and 20 cp. Round bulbs are made in 12 cp, 24 cp and 48 cp. Tungsten lamps of these candle-powers cannot be made at present for 60 volts, for the reason that the filament would be too delicate to stand the vibration. Tests on the 30-volt lamps mentioned have been very satisfactory, and indications are that they may be used in place of carbon lamps for train lighting. It was found impossible to place the tungsten filament support in the small bulb used in berth lighting. The snap lock of the berth receptacle was also an objection to using the tungsten lamp in such a location. In place of tantalum or tungsten lamps for berth lighting, a 30-volt, 15-watt, 6-cp Gem carbon-filament lamp has been developed. Tantalum lamps for train lighting are made for voltages from 25 to 65. In candle-powers from 5 to 23 they consume 2 watts per candle.

Another table submitted with the report showed a great increase in battery train lighting capacity offered by the tungsten lamp. For example, a given battery which would operate eight hours on one charge with carbon lamps would operate 25 hours in producing the same amount of light with tungsten lamps.

Work of Southern Power Company.

The Southern Power Company, of Charlotte, N. C., will take its power off the market within the next 60 days and after the expiration of that time those who wish power from the company will have to wait until the 99 Islands plant is completed. The Catawba Great Falls plants are now generating power with the revival of business in all lines of industry to their full capacities, which is approximately 50,000 hp.

The Rocky Creek development, which is now nearing completion, will furnish 40,000 hp, of which amount only 32,000 hp to 35,000 hp will be sold. The rest will be retained for reserve in case of a breakdown. Of the 35,000 hp available from the Rocky Creek station, 25,000 hp has already been contracted for and a sufficient number of outside contracts are pending to use all the power the station will furnish. This condition of affairs brings about an interesting situation. The Great Falls station is within two months of completion and with 25,000 hp already against it and enough contracts pending to use all the available power, another development by the Southern Power Com-

pany becomes immediately necessary. That development will be 99 Islands, work on which was started early last year, but was discontinued. The building of the dam across the French Broad River and power house will be contracted for at once. This is contrary to the policy heretofore held by the Southern Power Company, which did all of the construction work on the Catawba, Great Falls and Rocky Creek stations. The Rocky Creek station is not finished and the force there or any part of it cannot be removed to 99 Islands within the next two months, and for this reason the new station at 99 Islands will be built under contract.

The 99 Islands station will have a total capacity of 16,000 hp to 18,000 hp. The Catawba station has a capacity of 10,000 hp and the Great Falls and Rock Creek stations, sister plants, have an ultimate capacity of 80,000 hp. The four stations, with the completion of both Rocky Creek and 99 Islands, will have an ultimate capacity of 110,000 hp.

The Southern Power Company has contracts with 110 cotton mills in the Piedmont-Carolinas and is at present supplying power daily to between 80 and 90 of these. It is an interesting fact to note that 90 per cent of the power under contract is used by cotton mills, the remaining 10 per cent being used by small and diversified industries. In Charlotte alone the Southern Power Company is furnishing 2600 hp to operate small industries. This does not, of course, include the cotton mills of that city, for the Chadwick & Hoskins, the Louise, the Highland Park and other large industries of that class used several times the amount bought by the small industries. On one day of the week ending Nov. 14, the largest day in the history of the Southern Power Company, the meters registered a total of 46,656 hp used. The nearest approach to this was when a few days before the meters showed an output of 45,137 hp.

In addition to the above, it is stated that the Southern Power Company is to furnish power to Salisbury, N. C., by a new route in the near future, the survey having already been made. The new route leaves the power plant on the Catawba, thence by way of Lancaster, S. C., thence to Monroe, N. C., and to Albermarle and on to Salisbury. From Salisbury the power will go to Greensboro, and Salisbury is to be made a junction or distributing point. Already a portion of the right of way has been secured and it is expected to have the wires strung and the line in operation by early spring. Contracts for power have been made or are anticipated at all points touched by the new route. The old or present line will not bring power to Salisbury except in case of a breakdown on the new route. The present line brings power to China Grove, and that section of it from there to Salisbury will be of little use, but will be left for emergencies.

Pittsburgh Section, A. I. E. E.

The regular November meeting of the Pittsburgh Section of the American Institute of Electrical Engineers was held on Nov. 10 in the Carnegie Institute. Mr. W. Edgar Reed, chairman, presided. Although the weather was inclement 138 attended. The mining companies and the electrical profession in the entire surrounding district were well represented, including some engineers from the United States Geological Survey. The subject for the evening was "Electricity in Mines," an original paper presented by Mr. George R. Wood, consulting electrical engineer, of Pittsburgh, Pa., who took up the general subject and gave a very complete outline of the application of electricity to coal mining. The lecture was profusely illustrated by lantern slides.

The subject was discussed by Mr. F. L. Sessions, of Columbus, Ohio, chief engineer of the Jeffries Manufacturing Company; Messrs. W. A. Thomas, T. H. Schoepf, J. E. Mahoney and F. C. Albrecht, of the Westinghouse Electric & Manufacturing Company; Mr. H. L. Brown, of the General Electric Company, and Mr. H. W. Fisher, of the Standard Underground Cable Company.

The subject for the next meeting will be "Some Experiences in the Application of Gas Power in the Operation of 60-Cycle Industrial Plants, with Special Reference to the Plant of the Union Switch & Signal Company," an original paper by Mr. J. R. Bibbins, of the Westinghouse Machine Company.

Ithaca Section, A. I. E. E.

The first meeting of the section for the college year was held on Friday, Oct. 30. The program comprised an original paper by Mr. J. G. Pertsch on the general subject of "Alternating-Current Line Losses." Mr. Pertsch gave a summary of the investigations which have led up to Mr. Mershon's latest work, with especial reference to the researches conducted locally by Prof. Ryan. Following this paper was an abstract of Mr. Mershon's Atlantic City convention paper, prepared and delivered by Mr. W. K. Page. This was illustrated by lantern slides made for the occasion. The speaker brought out the essential features of the paper, and led up to a very interesting discussion by the members present. After the discussion the entertainment committee served refreshments. An informal smoker brought the exercises of the evening to a close.

This meeting was the first held in accordance with the plan laid out by the local program committee for the coming year. The plan is, briefly, as follows: Alternate meetings will be occupied with discussions of the New York and other institute papers, with addresses by prominent local and out-of-town engineers. The responsibility for the programs for the meetings is divided between two sub-committees. One of these, under the direction of Prof. F. Bedell, who is also chairman of the entire program committee, invites and entertains speakers from outside.

The other sub-committee, known as the "discussion committee," under the direction of Mr. L. F. Blume, arranges for the abstracts and discussions. In order that this committee may be familiar with the practical experience of the local members a canvass of the entire junior and senior classes, comprising nearly 600 men, has been made. Each student has been asked to write down on a printed form every detail of his practical experience. Thus, in preparing for a given discussion, the committee goes over this record, picking out the names of men who have had experience along the line of the paper under discussion. This feature has already proved of the greatest value and it was not very difficult to effect.

The discussion committee has also laid down a most important principle, namely, that each meeting shall be as far as possible self-contained. The abstract of any particular paper will always be preceded by what may be termed original foundation papers. This is necessary to prepare the audience for the proper appreciation of the topic. The discussion committee is also going to try occasionally an original experiment, by having different local members impersonate the engineers who have discussed the papers at the main institute meeting. Each will endeavor to obtain the point of view of the speaker, and he will be called upon by the name of the engineer whom he impersonates. Two objects, it is thought, will be gained by this proceedure: First, the spirit of the New York discussion will be repeated, and, second, the students will become familiar with the points of view of successful engineers. Undoubtedly some amusement will be caused by this impersonation, but there is no serious objection to a little fun in connection with the more formal part of the program.

At a business meeting held before the discussion a local tax of $1 per member was decided upon. This is necessary to defray expenses not properly chargeable to the institute. Mr. P. T. Vanderwaart was elected to represent the enrolled students on the local executive committee. The entertainment committee for the year was appointed, with Mr. F. C. Loring as chairman. At the present time there are three members and 12 associates connected with the Ithaca Section. The secretary has signed the enrollment blanks for 138 students, most of whom have already paid their enrollment fee. Altogether the work starts out with good promise of success, with largely increased enrollment and with excellent interest.

Proposed Power Engineering Association.

Mr. H. W. Peck, secretary of the Rochester (N. Y.) Railway & Light Company Section of the National Electric Light Association, writes us as follows with regard to the proposed formation of a separate power engineering association, as discussed recently in our columns:

"At a recent meeting of the executive committee of the Rochester Railway & Light Company Section of the National Electric Light Association, the matter of the organization of a power engineering association was discussed. This arose through the suggestion at the recent convention of the Edison Illuminating Companies and suggestions in two letters recently published in the ELECTRICAL WORLD that such an association be formed as an independent body. The committee feels that such an association would be of greater and more far-reaching value if organized under Article XVI of the Constitution of the N. E. L. A. as a National Special Section than if independent and has instructed me to communicate with you regarding this matter.

"It seems unquestionable that there is arising a strong feeling that the importance of power engineering, or perhaps more specifically, industrial power engineering, requires for the good of the profession more organized study and exchange of knowledge regarding this subject, also that the matter be taken up with such enthusiasm and wide-spread notice that the attention of the power users especially be attracted to the importance of this part of their business. We believe that the only general question regarding the matter is that of the form of organization, whether independent or affiliated with some existing organization; if the latter, with which organization. It is the unanimous opinion of this committee that the best results of a power engineering association can be obtained if such association be a 'special section' of the National Electric Light Ass'n.

"The oft-repeated arguments for the centralization of control and effort in manufacturing lines applies equally well, we believe, to the associations of learning. We believe that the expense and effort of organizing and conducting a separate organization, necessarily duplicating in most respects the expense and efforts of other associations, is unwarranted and will result unquestionably in a more limited value to the new association. A separate organization would deprive the present association of additional membership which would be attracted to it by the formation of a power engineering section; it would deprive both associations of mutually valuable papers, which must be presented before one or the other, but not before both independent associations.

"It is inconceivable that a new organization can be conducted along such economical lines that individual membership will be possible at less cost to individual members, yet the value to them will be very much less than would be membership in the National Electric Light Association with a Power Engineering Section.

"We believe that the effort which has recently been expended toward the advancement of illuminating engineering would have been spent to greater advantage in every way if it had been expended toward organizing and conducting sections of the National Electric Light Association and of the American Gas Institute.

"The only advantage which we can see in the formation of a separate association is due to the limitation of membership of the National Electric Light Association, which will exclude a large number of engineers and electricians employed by large industrial concerns, who would have as vital an interest in the new association as any other class. It does not seem impossible for the National Electric Light Association to make some provision so that such persons could at least take advantage of membership in the section.

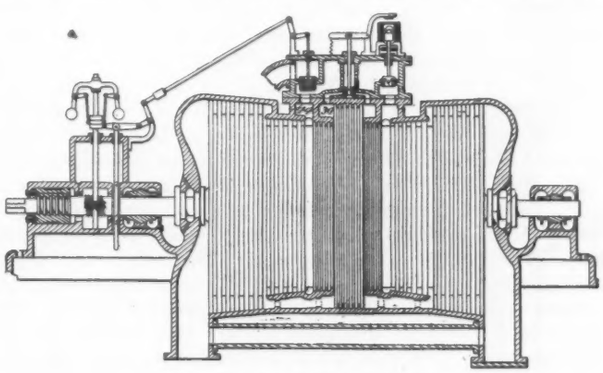
"We believe with Mr. Hillman and Mr. Seelman that the time is ripe for the organization of a power engineering association, and believing as we do that others will agree with us as to the form of the association, we desire to express our views through the valuable medium afforded by your paper."

Central Station Educational Work in Brooklyn.

The educational work of the Edison Illuminating Company, of Brooklyn, N. Y., which is now being carried on every Tuesday evening in the Edison Club Room, 8 Nevin Street, is more successful than any of the courses given in previous years. The general scheme of this work is somewhat different from that of the two previous years, in that the experimental lectures given by Prof. Sydney W. Ashe, apply directly to illuminating systems and particularly to the Brooklyn Edison system. These lectures are supplemented by talks by the department heads or their assistants, showing the special operating features which apply directly to the lecture of the evening. This combination method, resulting in a general co-operation between the management of the company, the various department heads and their assistants, the lecture committee, and Professor Ashe, has resulted in stimulating a very healthy interest. The total number of lectures to be given is 20, extending from the coal pile to the consumer. Four of these lectures, covering the generating part of the system, have so far been given and the average attendance per evening has been 183 men. The lectures are free to all employees of the company. Among those who have spoken so far at the lectures in addition to Professor Ashe may be mentioned Mr. W. F. Wells and Mr. Olaf Gates, on coal handling apparatus; Mr. Gates and Mr. G. L. Knight on turbines, and Mr. Shirgroe on switchboards. Weekly bulletins are issued calling attention to the lectures and giving directions for study. A detailed syllabus has also been printed and distributed to the men giving notes on the ground to be covered in each lecture. A set of reference books to be used in connection with the lectures has been purchased by the company, and placed in the library where they may be readily consulted.

Double-Flow Steam Turbine.

A patent has been granted to Mr. J. P. Nikonow covering the construction of double-flow steam turbines of the Parsons or reaction type. Steam turbines of this type are designed for maximum efficiency at a certain load and certain pressure. Speed regulation at different loads is attained by means of a throttling valve, operated by a centrifugal governor, so that the efficiency decreases at light loads. The same is true of the impulse turbines, embodying pressure stages, because the regulation by means of variable partial steam admission is of some



DOUBLE-FLOW STEAM TURBINE.

importance for the first pressure stage only, so that, practically, impulse turbines have the same efficiency curve as reaction turbines.

The steam turbine patented by Mr. Nikonow embodies certain improvements so as to increase the light load efficiency. As may be seen from the accompanying illustration, steam is admitted at the center, stuffing channels separating the two units. When the turbine is running at full load the steam from the chest enters the left unit through the proper port. At the same time, the magnet connected in series with the mains from the

generator, driven by the turbine, is fully energized and holds its plunger up, thus opening the valve and admitting steam into the port of the second unit. Consequently, the two turbine units work in parallel. With a decrease in load, below one-half normal, the magnet releases the plunger, thus closing the valve and cutting off steam from the second unit. The remaining unit works at half load with full pressure of steam, and consequently, with high efficiency. The non-working unit runs in vacuo and, therefore, without appreciable friction or windage. A centrifugal governor of ordinary design controls the steam admission through the main valve regardless of whether one or both units are working.

Letter Telegrams.

The French Government has established a leter telegram service similar to that which Mr. Patrick Delaney has for the past 20 years or more advocated in this country. Under the French system letters are transmitted during the night hours for delivery in the morning, the charge being one-fifth of a cent a word. As advocated by Mr. Delaney, the telegram-letter would be prepared by the sender by means of a special perforating typewriter, the message thus being made ready to be put without further manipulation through an automatic telegraph transmitter. At the other end it would be typewritten by the telegraph receiver and either delivered through the local mail service or a special delivery service.

Hydro-Electric Meeting of the New England Street Railway Club.

The New England Street Railway Club held a meeting on Nov. 19 which departed somewhat from the usual discussion of immediate problems of electric traction, through the consideration of water-power resources by Mr. J. F. Vaughan, of the Stone & Webster Engineering Corporation, Boston. Mr. Vaughan presented an admirable paper commending the conservative policy of the National Government, pointing out the opportunities afforded by electric transmission to the development of scattered water powers not yet utilized, and discussing the operating economies to be enjoyed through the installation and running of scattered plants in single comprehensive systems. He showed the importance of controlling stream flow as a whole to utilize the maximum energy of the whole river, and recommended co-operation of power users in the construction of storage reservoirs. Plants can be tied in so as to equalize peaks, cut down distribution costs, reduce reserve capacity, improve regulation, tie in equipment so that the investment in high-tension switching apparatus is lessened, and improve the load factor. Power can be interchanged when peaks do not coincide, and there is a field for the use of power in electrochemical work at times when the system is lightly loaded.

Mr. H. S. Harriman, of the Connecticut River Power Company, discussed the paper, outlining as a concrete case of advanced hydro-electric development in New England the work his organization is prosecuting near Vernon, Vt. Although New England has been a pioneer in the mechanical utilization of water power on a large scale, it has until lately been slow to adopt high-voltage transmission over long distances. At Vernon a plant is being built which will develop about 16,000 hp for 12 hours of the day, and it will be transmitted at about 70,000 volts to cities in Worcester County, the distance being about 60 miles. A dam is being constructed which will provide a head of about 34 ft., and will back up the water for about 20 miles of storage. The line will be carried on steel towers through a nearly straight route to the towns of Gardner, Fitchburg, Clinton and Marlboro, with about 7 per cent loss. The line will cut a swath about 100 ft. wide with a private right of way across country, and one tangent is 15 miles long. A number of small powers of from 500 hp to 2000 hp have been discovered on the way and these may later be developed for systematic operation with the balance of the plant. By the use of the electrolytic arrester and the overhead guard wire Mr. Harriman expects to eliminate most of the lightning troubles. Discussing further probable high-tension development in the New England field, Mr. Harriman stated that within the last 10 years the cost of coal at the mine has advanced from about 80 cents per ton to $1.30, or over 50 per cent. This condition of affairs is bound to be effective in stimulating further power transmissions over long distances and wide areas electrically in the East. Two lines are now in use in this country at about 100,000 volts, and it is probable that 150,000 volts will be commercially available within the next 5 or 10 years. This means that it will be profitable to transmit power to the right markets at distances of 300 miles to 400 miles from the plant, and the St. Lawrence River, within 250 miles of New England, illustrates how from 3,000,000 hp to 4,000,000 hp now going to waste may ultimately be turned to account for New England's industrial use. In this connection it is probably that the steam plant will be retained largely as an auxiliary for the hydro-electric development, operating as a reserve when occasion demands.

Electrical Growth in Boston During the Past Three Years.

Electrical developments in Boston during the past three years show a gratifying growth, according to statistics that have been prepared by the wire department. On Jan. 31, 1905, the total horse-power of boilers in central station, railway, and isolated plants in Boston was 117,673. The total horse-power in engines in these plants was 145,717. The connected load of the plants in incandescent lamps was 874,539 16-cp units, and there were 14,441 arc lamps in the service of these installations. The number of stations was 299, with a connected motor load of 179,910 hp, distributed through 13,250 electric motors.

On Jan. 31, 1908, the following equipments were in use:

	Boiler hp.	Engine hp.	Incan. lamps.	Arc lamps.	Number of motors.	HP of motors.	Number of stations.
Boston El. Ry. Co....	39,138	64,950	66,149	625	5,401	226,607	10
Edison El. Ill. Co....	25,456	71,200	749,087	9,169	9,200	35,953	13
Charlestown Gas.....	475	140	—	—	80	503	—
Boston Consol. Gas...	1,500	3,100	96,170	604	121	486	1
Block Plant Co.....	273	417	5,250	—	3	16	1
Sudbury Bldg.	202	230	656	—	30	140	1
Steam & Power Co...	267	295	4,000	400	60	294	2
Hecht Bldg.	300	200	2,400	240	32	234	1
Isolated plants	64,859	44,471	223,000	3,869	1,472	11,428	301
Total	132,470	185,003	1,146,712	14,907	16,399	275,661	330

These figures show that in boiler horse-power there was an increase of 12.6 per cent; in engine horse-power, 21.6 per cent; in incandescent lamps a gain of 31 per cent; in arc lamps a gain of 3.1 per cent; in number of motors connected, a gain of 23.8 per cent; in the horse-power of motors connected, a gain of 51.5 per cent; and in the total number of plants, a gain of 10.4 per cent. The most striking feature of the increase in electrical development is the growth of the railway and industrial service. The Edison Company's industrial business, as expressed in connected motor horse-power, gained nearly 50 per cent in three years, while the number of isolated plants increased only one-fifth as fast as the Edison service. In the isolated plants the generating equipment increased only about 14 per cent, as compared with the Edison increase of almost 50 per cent in plant rating. These figures show incidentally that isolated plants in Boston is gradually being replaced by the Edison service, and the enormous growth of the industrial and lighting load of the latter company show that the work of its business-getting organization, together with lighting rate reductions, have been exceedingly effective.

It is interesting to note that the lighting load of the Edison company gained about 30 per cent in the three years. The lighting load in the isolated plants gained about 10 per cent in this period. In considering the small growth of the isolated plant installations it is worth noting that the total kilowatt

rating of all of the isolated plants in Boston on Jan. 31, 1905, was 21,177 kw, and that on Jan. 31, 1908, it was but 22,251 kw. In other words, the isolated plant electrical generating equipment shows a much wider discrepancy between the engine horse-power of the investment and the rating of the generators than is the case with the central station. The reserve equipment of the isolated plant is liable for several reasons to be larger than is required proportionally in a motor-driven installation requiring large fixed charges. The actual gain in isolated plant generating rating expressed in kilowatts was only 1074 kw, or 5.1 per cent larger than in 1905. In actual value the Edison company gained 17,300 kw, or 17 times the gain in isolated plant electrical equipment. The advance of the incandescent lamp into the field formerly occupied exclusively by the arc is also reflected in the above figures. The arc lamp connected load was barely maintained in the cases of both the Edison company and the isolated plants, while the connected incandescent lamps forged ahead well in both instances.

Large Public Demand for Small Tungsten Lamps in Boston.

The experience of the Edison Electric Illuminating Company of Boston in connection with the introduction of the 25-watt tungsten lamp in its territory has clearly shown a general tendency on the part of the consuming public to take advantage of the improved conditions. Before many lighting experts had made up their minds as to its possibilities, the Boston company had given the lamp a thorough practical testing and was prepared to put the larger sizes promptly into service among its customers. The Boston company was also early in the field with the smaller candle-power lamps, pushing through advertising and its agents the introduction of these units in its territory. The company states that no other central station has distributed among its customers enough of these lamps to make possible any close comparison with the work which has been done in Boston.

As soon as the Boston company decided that its customers should have the advantage of the 20-cp lamp, its 25,000 customers were given an opportunity to place their orders in advance of new customers who would be anxious to install electricity, now that the cost in Boston is one-half what it was a year ago. These orders amounted in a few days to 4009 lamps. The demand was so great, however, that President C. L. Edgar discovered that the supply would soon be exhausted, and within half an hour of this discovery two men were on their way to the Harrison factory of the General Electric Company, with instructions to bring back as personal baggage all the tungsten lamps they could lay hands upon. Since that time the lamps have been shipped in almost as fast as they have been made, and the company is working night and day to help its old customers and the many new ones who are being added to its service to obtain the most improved form of lighting at the lowest cost.

CURRENT NEWS AND NOTES.

LIGHTING STREET ARCHES.—The Merchants' Association of Appleton, Wis., has had erected 19 electrical arches over College Avenue, a main thoroughfare, from Superior Street to Drew Street, of four blocks. These arches will be used for holiday and permanent decorations. There are 75 incandescent lamps on each arch.

ILLUMINATING ENGINEERING.—The next meeting of the New England section of the Illuminating Engineering Society will be held in the Edison Building, Boston, when Mr. H. W. Moses will read a paper on the work of the division of illuminating engineering of the Edison Electric Illuminating Company of that city. The date of the meeting is Dec. 3, at 7:30 p. m.

ORANGE, N. J., MUNICIPAL PLANT.—The Supreme Court of New Jersey has been sustained by the Court of Errors and Appeals in its decision against a municipal plant for Orange, N. J. The former court held that a city in order to establish an electrical plant by virtue of the act of 1906, must at the time it assumes to exercise the authority, be possessed of some plant, appliances or machinery already established in connection with its public water supply, and from which, by some practicable method, it may derive mechanical power, which, either alone or together with additional power to be developed for the purposes, may be used in furnishing energy.

AMERICAN PLATINUM.—It is noted that the decline in price of ingot platinum on the New York market from $38 per troy ounce on Jan. 1, 1907, to $25 per ounce on Dec. 31 of the same year, was accompanied by a notable decrease in production of American fine platinum—from 1439 ounces, valued at $45,189, in 1906, to 357 ounces, valued at $10,589, in 1907. Of the total output in the later year, 300 ounces came from Butte, Del Norte, Humboldt, Placer, Plumas, Trinity and Sacramento Counties, in California, and 57 ounces from Coos, Curry and Josephine Counties, in Oregon. In an advance chapter from "Mineral Resources of the United States, Calendar Year 1907," on the production of platinum in 1907, David T. Day, of the United States Geological Survey, says: "The decline in price in the United States increased the feeling of insecurity on the part of the platinum miners as to the value they would secure from their material and rendered the search for platinum less active." The total value of platinum metals imported and entered for consumption in the United States in 1907 is given as $2,684,642—a decrease of $1,104,117 as compared with the value of the imports in 1906. Continued interest is shown in the project for developing the platinum localities in the Department of Cauca, Colombia, but development work has not yet reached the point of commercial production. Contracts for practically the entire supply of platinum in Russia have been made for a number of years ahead, and fluctuations in prices have no significance in regard to the total annual output.

ILLUMINATED STREET SWEEPERS.—Electrically lighted "white wings" is one of the newest innovations, and has proved so satisfactory that it is predicted the system will become popular in all cities where men are employed at night for keeping the streets clean. The South Park Board of Commissioners, Chicago, Ill., employs a number of street cleaners at night on Michigan Avenue between Jackson Boulevard and Twelfth Street, and on Jackson Boulevard between Michigan Avenue and the river. These streets are the prominent downtown driveways for carriages and automobiles. The commissioners found that the work of cleaning streets at night was hampered and the lives of the members of the "white wing" squad endangered by the automobiles and coupés which use these driveways. To make the work of street cleaning less hazardous Mr. H. S. Richards, assistant superintendent of the South Park Board, devised a plan whereby the men could, without difficulty, carry a signal lamp that would clearly mark their presence at any point on the driveways. The batteries used in the man-lighting scheme are of the 2-volt, 6-amp type and are designed to burn continuously 10 hours, after which they are re-charged. Small tungsten lamps are used. The combined weight of the outfit is about three-quarters of a pound. The battery fits into the hip pocket of the sweeper's trousers. The leads run from the battery under the man's coat to the lamp, which is attached to his helmet. The battery is connected up when the man goes to work at night and is left connected until he quits work in the morning. It was originally planned to use red lamps on the helmet, but the clear white lamp was substituted because it could be seen from a greater distance. The plan has worked so well it is announced that it will be permanently adopted by the commission for the use of the night squad employed on streets where their work is hampered by vehicles.

MEMORIAL TO PROF. BELL.—The Bell Memorial Association at Brantford, Ont., announces that the former homestead of Prof. Alexander Graham Bell will be acquired as a public park in addition to the erection of a memorial monument to cost $25,000. This monument will be unveiled in 1910.

BRITISH-CANADIAN CABLE.—According to a dispatch from Ottawa, Ont., it is stated there that the Hon. R. R. Lemieux, who is now in London, has closed definite arrangements with the British cabinet to lay a government cable between Great Britain and Canada at the joint expense of the British, Canadian, Australian and New Zealand governments.

POWER ENGINEERING.—Mr. Eugene A. Creed, of the Auburn (N. Y.) Light, Heat & Power Company, writes us as follows: "Let me say, as does Mr. M. S. Seelman, Jr., that I am most heartily in favor of Mr. Hillman's idea of forming a power engineering society. My services in helping to form a society that is bound to be beneficial to the central station are at the disposal of Mr. Hillman, even though they may prove to be slight."

GYROSCOPE COMPASS.—A special dispatch from Charlottenburg, Germany, of Nov. 19, says: "At a meeting of the League of German Naval Architects to-day, Dr. Anschuetz-Kaempfe, of Kiel, exhibited a compass without a magnetic needle which has just been invented. It is in the form of a gyroscope, which, when suspended in a certain way, always adjusts itself parallel to the earth's axis. The invention is regarded as of great importance to ironclads, where the compass needle frequently is deflected by adjacent metal."

TELEGRAPHING LETTERS.—A special dispatch from Paris, of Nov. 17, says: "The Ministry of Posts and Telegraphs has supplemented the existing special letter delivery system in France with what are termed 'letter telegrams.' This new system provides that letters may be telegraphed between any two points in France at night at a cost of one-fifth of a cent a word, and that they will be delivered the next morning." This system corresponds roughly to the Delany "Telepost," which is now in actual operation over limited lines in New England. There certainly seems to be a large field in both Europe and America for such development.

NEW YORK WATER-POWER RIGHT.—The New York State Court of Claims has sustained the right of the Fulton Light, Heat & Power Company, of Fulton, N. Y., for compensation due from the appropriation for canal purposes of land and developed and undeveloped water power on the Oswego River owned by the company. The damage claimed was $3,428,028, but the amount will be determined in other proceedings, which the present decision allows to be instituted. The main points covered by the opinion are that a State patent bounded by a fresh water non-tidal stream carries title to the center of the stream; that a private individual may acquire title by prescription in the bed of such a stream, even though the stream may be navigable.

A PLAGUE OF CRICKETS.—The story was circulated recently that a plague of crickets had shut down completely the municipal lighting plant at Austin, Tex. In regard to this occurrence, Mr. George Fiegel, the city electrician, writes us as follows: "Our plant is made up of 60-cycle tri-phase generators, feeding to the main bus on the switchboard, where it distributes to six single-phase circuits, and one tri-phase motor circuit. One generator is left off of the main bus, and is used to carry three series alternating arc circuits. On Oct. 27 we had a 'norther' (a cold wave), which usually brings great numbers of crickets. The crickets were attracted by our arc lamps, which are suspended from towers, 159 ft. high. On this occasion, the screens at the plant were left open, and the crickets went in behind the switchboard, swarmed over a large three-pole knife switch, used to cut the primary current from the house transformers, and caused the current to jump across the blades. This switch is cut straight on to the main bus, and therefore requires the killing of all the machines feeding to it. The engineer was ordered to take care of his engine when this load dropped off, and misunderstanding his orders, he shut the engine down, and in doing so, cut off the city street lights, which was entirely unnecessary, as the generator pulling them is on a line shaft with other generators and is independent of the main bus."

CHICAGO EDISON GROWTH.—The output of electrical energy by the Commonwealth Edison Company has recently increased rapidly, with the result of making new records. On Friday, Nov. 13, the maximum load went over 110,000 kw. The system first passed the 100,000-kw maximum at 5:15 p. m. on Nov. 4, as follows: Harrison Street station, 8830 kw; Fisk Street, 85,400 kw; batteries, 7780 kw; a total of 102,010 kw. By Nov. 12 this ran up to 106,900 kw at 5 p. m., distributed as follows: Harrison Street, 9900 kw; Fisk Street, 85,500 kw; Quarry Street, 11,500 kw. It is expected that the maximum during the winter may run somewhere between 114,000 kw and 120,000 kw. It will be noted that on Nov. 12 the new Quarry Street plant was running. The units in this station are guaranteed to run 14,000 kw 24 hours in the day. The first unit is now in regular operation, and the next one will be cut in sometime between now and Christmas.

POSSIBLE COMMISSION FOR ILLINOIS.—The *Chicago Tribune*, in a recent issue, states that Samuel A. Ettelson, a member of the Illinois Legislature, is preparing to introduce a bill in the next session providing for the creation of a commission that will have jurisdiction over railroads, street car lines, gas and electric light companies and telephone systems. The bill is somewhat like the law in New York. It would in effect limit the power of various local authorities over public utilities. It is stated that this bill will provide for seven commissioners on salary at $10,000 each, one attorney at $10,000, and a secretary at $16,000. It would appropriate $200,000 for the salaries and expenses of the entire commission. The members would be appointed by the Governor. It gives the people the right to appeal to the commission whenever any of the public utility corporations are alleged to be guilty of abuses and to call upon the commission to investigate and remedy them, if necessary. At the same time, it affords protection to the corporation, as it practically centralizes authority in the commission.

CHEAPER CABLE SERVICE.—With regard to the agitation for cheaper Atlantic cable service and the proposal for governmental cables, Mr. Frederick Ward, of the Commercial Cable Company, in London, is quoted as follows: "The idea of the English and Canadian governments laying a cable between England and Canada," said Mr. Ward, "would be a grave mistake, similar to the mistake made when laying the British-Canadian-Australian Pacific cable. That cable cost the taxpayers about £2,000,000, and its operation brings no income on this vast sum of money, but, on the contrary, that cable loses about £65,000 a year, which has to be paid by the taxpayers of the three countries. We have had quite enough of that, and I am surprised that any such proposition is being considered in view of our high rates of taxes at present and our deficits on the Inland Telegraph Service and Australia. On the Pacific cable I understand that 10 cents a word would not pay the cost of operation. I consider a shilling a word a fair rate when it is borne in mind that the sender of the telegram can, by the use of a code, convey from 20 to 50 words to his correspondent at the price of a shilling, or less than a half-penny a word. I also understand that 98 per cent of cablegraphing is in code words by persons using the cables every day. The other 2 per cent, which is social, is widely scattered and probably a person who would send one social message to-day would not have occasion to use the cable again in six months." He pointed to the generally low quotations for cable securities.

German 50,000-Volt Transmission System.

TO supply the city of Munich with additional electrical energy, and to run in parallel with the several existing municipal steam and hydraulic plants, a new municipal hydro-electric plant has recently been completed.

It utilizes the water of the river Isar in Moosburg, where three 1887-hp, double twin turbines are installed. Energy is generated at 5000 volts, but the e.m.f. is increased to 50,000 volts for transmission over two parallel circuits to the sub-station near the city of Munich, where the e.m.f. is decreased to 5000 volts for distribution.

This plant, known as the Uppenborn station, being the latest of German hydro-electric undertakings, possesses many novel features, particularly on the electrical end.

Thirty-three miles below the city of Munich the river Isar makes a bend, which is cut off by a head and tail race canal about 2.5 miles in length, giving a net fall of 28.1 ft. at low water and 24.8 ft. at high water. Permission was given to draw 2500 cu. ft. of water per second during 207 days, while during the remainder, including the dry season, only 1070 cu. ft. is available.

Just below the junction of the head race and the river a dam was thrown across the river at about right angles. For this purpose the width of the Isar was increased from 225 ft. to 619 ft. On the opposite end from the intake is a spillway, 328 ft. long. Adjoining the spillway is a fish passage 6.5 ft. wide, built up in steps. Next to this are the sluice gates for regulating the head. They are divided into four sections, each 55.7 ft. wide, three of which are separated by concrete pilasters, while the fourth is separated by a lock 26.25 ft. wide for passing boats, etc. This lock, having two mechanically operated swinging gates on the up-stream end, is about 150 ft. long. The bottom has a slope of about 2 per cent. It is made of concrete covered with planking.

The sluice gate passages adjoining the lock are subdivided into two sections by a removable guide, for the purpose of giving free passage for floating débris, etc. The two passages near the intake are divided into three sections, and the guides here, for the sluice gates, are stationary.

Each sluice gate is divided into two sections, one upper and one lower. They are, however, not of the same size, the lower being the smaller, thus enabling the sections, due to the hydrostatic head, to be operated by the same amount of power. Two such sections, or one gate, can be lifted by a three-phase, 10-hp motor in 10 minutes. When operated by a hand windlass with a ratio of 1:2800, 50 minutes are required to lift one section. On the down-stream side of the gates, resting on the concrete piers, is an operating gallery of structural steel.

The bottom of the intake to the head race is about 7 ft. above the bed of the river, thus preventing foreign material, such as gravel and sand, from entering the head race. As this provision cuts down the depth of the water to 4.9 ft., the width of the intake was made 125 ft., thus giving a velocity of 3.9 ft. with a friction or head of loss of 4 in.

This intake passage is divided up by a massive concrete pier, and in order to further reduce the size of the sluice gates they are subdivided into four sections by structural steel sluice guides. Each gate is divided in two parts and operated in the same manner as those described above.

At the side of the dam and intake is an attendants' house, which contains also a transformer for supplying energy to gate motors. On the other side of the intake is a lock, similar to the one mentioned, for passing boats into the head race.

The head race canal is 1.3 miles long, and is built with a slope of 1 in 3000 for a calculated velocity of 4 ft. per second. It is 54.5 ft. wide on the bottom, with side slopes of 1-to-1.5. Under ordinary conditions the depth of the water is 9.2 ft. Throughout the greater part the sides of the canal are finished off in embankments, which, at the highest point, are 16.5 ft. above the natural ground.

FIG. 1.—VIEW OF POWER HOUSE AT UPPENBORN.

At a low point the head race crosses a creek which is passed underneath through two culverts.

GENERATING PLANT.

The power house lies across and at right angles to the head race, which is here 175 ft. wide. At one end of the power house is a lock for passing boats and a fish way, similar to those at the dam. At the other end is a sluice gate and passage for letting off the head race water into the tail race; the latter is 1.1 miles long. Some difficulty was encountered during the excavating, because part of the work runs through marshy land.

At an angle of 72 deg. to the flow of the water to the turbine chamber, and in front of the sluice gates, are racks built up of 2.25-in. x 0.25-in. bars, spaced with a clearance of 1 in. The sluice gate for each turbine is 11.5 ft. high and 24 ft. wide. It is divided vertically into three sections, which can be interconnected for motor operation.

The sluice gate seen foremost in Fig. 1 is 14.8 ft. high and 13.1 ft. wide, and its purpose is for emptying the head race as above indicated. On the other end of the sluice gates is the gate for the lock; it is 26.25 ft. wide and 16 ft. high, and is lowered when the water is left off. All sluice gates, with the exception of the latter, can be motor-operated. On the down-

stream side of the gates is a gallery from which they are operated by hand.

The turbine chambers are located between the gates and the generator room, the roof being flush with the street and made of reinforced concrete. There are installed three twin inward-flow Voith turbines, mounted on a horizontal shaft, each having an output, with a water consumption of 785 cu. ft. and a head of 26 ft. of 1887 hp at 150 r.p.m. Each twin turbine has its own draft tube; the two of a complete unit join into a single draft tube, which is part of the foundation and discharge into the tail race.

During the greater part of the year there is surplus water, to utilize which a 224-hp twin turbine, consuming 100 cu. ft. of water per second, making 300 r.p.m., has been installed. The generator of this turbine is a three-phase, 5000-volt, 50-cycle machine, designed for an output of 210 kw at a power factor of 0.9. To the unit there is coupled a 110-volt exciter. The operation of this set is kept independent from the remainder of the plant, as it supplies energy for the city of Moosburg. However, provision is made so that in case of emergency it can be joined in parallel with the rest of the plant, as will be seen below.

The regulation of each of the main turbine sets is accomplished by an oil-actuated, hydraulic governor, located in the generating room. The oil is supplied at 295 lb. pressure by pumps operated from the turbine shafts. The oil piping of the different pumps is interconnected so that one may assist another. For synchronizing the generators the governors are equipped with small motors controlled from the main switchboard.

The turbine shafts are rigidly coupled to the shafts of the three-phase alternators, which are of the revolving-field, 5000-volt, 50-cycle type. With unity power factor the output of each generator is 1400 kw. Overhanging on each shaft is mounted a 17.5-kw, 110-volt exciter.

To accommodate the type of turbine generator installed the floor had to be placed about 21 ft. below the ground level, which is about 3.5 ft. above the high-water level in the tail race, thus placing the bottom of the generator pit some 6 ft. beneath the high-water level. To prevent seepage from entering the generator pits, and also the trenches for the generator leads to the switchboard, they are lined with steel plates. For the same reason, the generator leads are taken off from the upper part of the armature and passed through a column to the trenches leading to the switchboard.

The generating and switching rooms are housed under a common roof. The former is 103.3 ft. long and 26 ft. wide. In order to give the generating room a pleasing appearance, a ferro-arched ceiling is built up under the roof truss, 38 ft. above the floor level. The whole room is kept in light color, and well illuminated. The floor and wainscoting are tiled.

SWITCH GEAR.

The three main generators feed energy into one busbar system, connected at each end to transformers. Between the junctions are sectionalizing switches and on both sides of each are cut-out switches, thus keeping the two outgoing lines to Munich entirely separate. All switching is done on the 5000-volt side, there being no high-tension busbars.

For each outgoing line there is one three-phase transformer of 2000-kva rating for increasing the e.m.f. from 5000 volts to 50,000 volts. They are of the Siemens-Schuckert, oil-insulated, water-circulated type. By using 60 cu. ft. of cooling water per hour, with the transformers under full load, the temperature of the oil surface is 95 deg. Fahr. above that of the incoming water. The efficiency at full load is 98 per cent. The ohmic resistance drop is 0.95 per cent, while the impedance voltage at full load current is 3.5 per cent.

The secondary windings of the transformers are split up into sections with the leads brought outside, so that they can be readily changed from star to delta connection for giving a 25,000-volt transformation if desired.

The transformer casings are made of steel plates, and rest on rollers and tracks, whereby they can be shifted to the generating room and there handled by a 16-ton overhead crane for repairs. Each transformer, when filled with oil, weighs 11 tons.

A novel feature in connection with the transformer, and of especial value to hydraulic plants, is the utilization of the circulating water of the transformers for heating the various rooms of the plant.

The water for cooling the transformers, as well as that for the water-jet grounders and for drinking purposes, is supplied by a 5-hp centrifugal pump, which delivers to an elevated tank. The pump works automatically between the limits of 45 lb. and 75 lb. Use is made of a 3-hp auxiliary pump when the cooling water of the transformers is utilized for heating purposes. Another pump removes possible seepage.

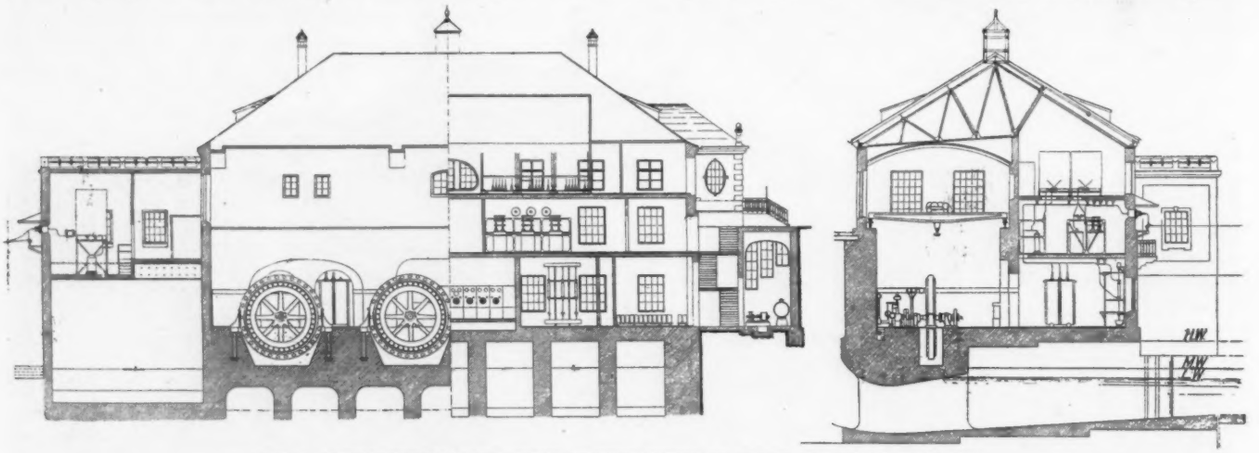


FIG. 2.—LONGITUDINAL AND CROSS-SECTION VIEWS OF POWER HOUSE, UPPENBORN.

In front of the switchboard is a controlling bench from where the generator room is readily overlooked. It contains all levers and wheels on the flat surface, while the instruments are mounted on the incline. From this desk the attendant starts the turbines by means of the motors on the sluice gates. Moreover, the field and speed regulation, synchronizing as well as loading the generators, is done from this point without the attendant losing sight of the generating room.

The switchboard is made up of seven panels, four for generators and three for the outgoing lines. All are of the wagon panel type of the Allgemeine Elektricitäts Gesellschaft, consisting of a small carriage resting on wheels upon the steel framework of the switchboard. The advantage of the wagon panel system is that the panel, with equipment, can be readily withdrawn for inspection and repair. The electrical connections are made by copper clips on the back of the carriage, which is done by sliding in the wagon panel. Each generator panel contains an oil-switch provided with an overload and reverse-current time-limit relay, which can be operated by a hand wheel on the panel or by a pilot switch on the controlling bench. The two series transformers for the relays and one for the ammeter are also placed in the carriage, while the switch indicators are located

on the controlling bench. There is also a small three-phase transformer for the synchronism indicator and one for the wattmeter; the instruments themselves are placed on the controlling bench.

The individual equipment of the carriages are disconnected by small switches placed in a row on the switchboard front.

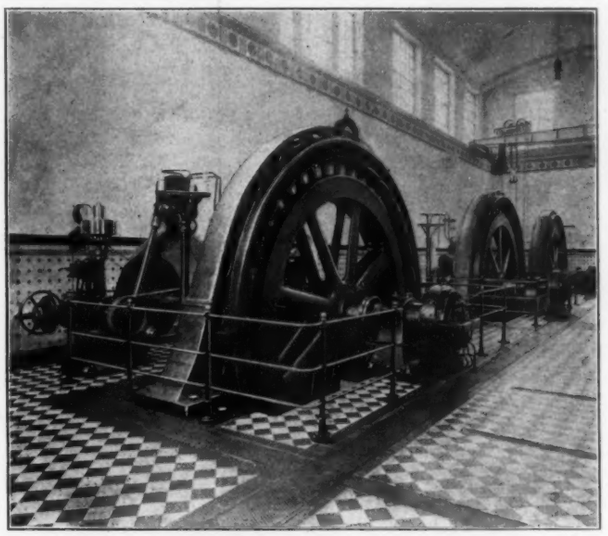


FIG. 3.—VIEW OF GENERATING ROOM, UPPENBORN.

Each of the transformer panels contains an oil-switch with an excess-current cut-out and a wire break relay; three series transformers; one ammeter with its transformer; one potential transformer, and two dry elements for the wire break relay.

In the power house, as well as the substations, there are very extensive systems for protection against lightning. The equipment in the power house is as follows: For direct lightning strokes there is placed at each phase-lead a horn-gap of 9/16 in., connected to large water rheostats, located in an annex of the power house. In the upper floor of the switching rooms are four choke-coils connected in series, each preceded by a horn-gap. Between these and the transformer is a coil known as the generator choke-coil, which is also provided with a horn-gap. All of the gaps for each phase lead (2.25-in. setting) have a common ground. To the grounding device is connected an oil rheostat to prevent the generator current from following the lightning stroke. To take care of light surges, water-flow grounders are installed.

To equalize the pressure between the phases, there are three

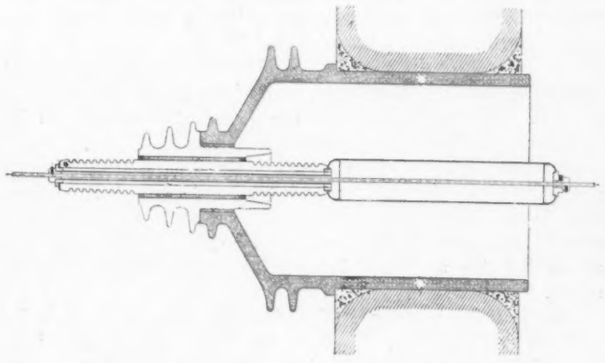


FIG. 4.—WALL OUTLET OF 50,000-VOLT TRANSMISSION SYSTEM, UPPENBORN.

horn spark-gaps connected in "star" to the middle point of the transformers.

It might be of interest to state that the water-flow grounders are designed to carry off from 0.1 amp to 0.15 amp, according to the chemical composition of the water. This means that a three-phase grounder leads off 9 kw, and the power for four grounders amounts to 36 kw, which is less than 1 per cent of the power to be transmitted. The water is supplied by two centrifugal pumps.

The horn-gaps, of which there are five per phase lead, are spaced 8 in. apart. The others of the different phase leads are spaced 6 ft. apart, between which are double abestos partitions 7.8 ft. high. As they are located on the upper floor of the switching rooms, the roof and roof truss over the horn-gap room is lined with cork-plates covered with an incombustible material.

As stated, the 210-kva generator, supplying 5000 volts for the city of Moosburg, is, under ordinary conditions, operated independently of the rest of the plant by means of sectionaling switches in the busbars. The energy is conveyed by means

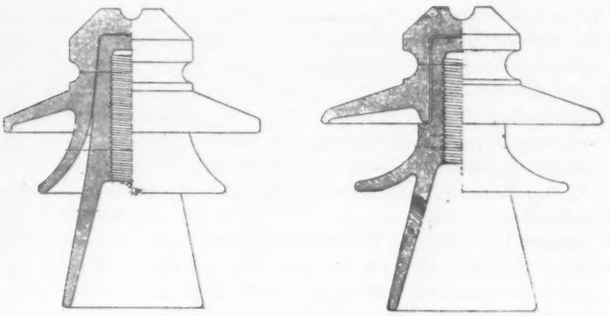


FIG. 5.—TYPES OF 50,000-VOLT INSULATORS.

of a cable running along the head race. At the attendants' house, near the dam, a tap is made to feed a 30-kw, 5000-volt to 110-volt transformer for operating the sluice gates.

All station insulators for 50,000 volts are made up of three corrugated cylindrical porcelain sections, held together by a mechanical screw coupling. The height over all is 11.5 in.; the diameter of the lower section is 5.5 in., and that of the remainder, 3.75 in. The design is such that the total porcelain thickness between the metal couplings is 2.25 in., while the surface leakage path is 23 in. The corrugations have the effect of making the high pressure noticeable by loud hissing dark dis-

FIG. 6.—TRANSFORMER STATION AND LIGHTNING ARRESTER HOUSE, HIRSCHAU.

charges, but without measurable loss. These insulators are placed at least 20 in. apart, while those carrying ground connections are spaced not less than 12 in. apart.

The high-tension wall-outlets on the main as well as on the substations are of the design seen in Fig. 4. An outlet consists

of two concentric corrugated poreclain bushings cemented together, which in turn are cemented in the bell-shaped end of a tile cylinder 16 in. in diameter. As the radius of the line conductor is only 3.5 mm., it was thought advisable to increase its diameter artificially by placing a brass tube 85 mm (3⅜ in.) around the conductor, thus cutting down any arcing effect due to brush discharges. Although the distance between line and ground is reduced, the arcing effects are no more noticeable.

TRANSMISSION SYSTEM.

The transmission system is 32 miles long, and calculated to transmit 4000 kw at 50,000 volts, for which purpose two separate transmission lines were installed. The conductors consist of a seven-strand cable, 16 sq. mm in cross-section, and spaced 4.6 ft. on a leg. Under normal operation both circuits are alive, and under this condition the total resistance drop is about 1100 volts and the reactance drop 430 volts. The power-factor at the power house is 0.95, while at the substation it is unity. This difference is due to the charging current.

As will be seen in Fig. 5 there are two different kinds and manufacture of line insulators; both are of the three-petticoat, two-piece type glazed together in the manufacture. The insulator shown at the right-hand is 9 in. high, the head being 8.75 in. diameter. The other is 10.25 in. high, the head being 9.5 in. in diameter.

Before the contracts for the transmission structures were let, tests were conducted on (1) wooden A-frame structure, (2) steel tube poles, (3) Mannesmann tube poles, (4) latticed tower of angle iron, (5) I-beam A-frame.

The following table gives a comparison of the tests on the above structures, together with the price in marks. The structures are tabulated successively, as above numbered, and are expressed in the metric system and serve for ready comparison:

	1.	2.	3.	4.	5.
Safe load in kg	100	1,800	2,200	870	1,800
Cost, including two arms, in marks	35.20	40.35	45.20	80.70	40.00

It will be noticed that the wooden structure was not favorable, especially as the line passes through marshes, and the life of a

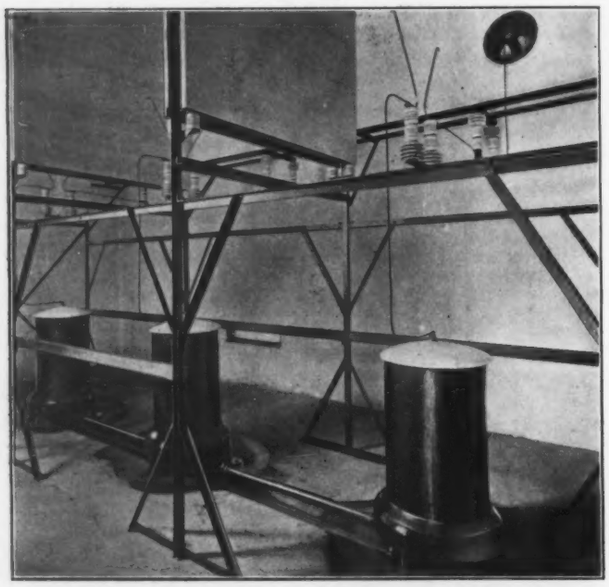


FIG. 7.—HORN GAS AND RHEOSTATS, LIGHTNING ARRESTER HOUSE, HIRSCHAU SUBSTATION.

wooden structure is short. The I-beam structure outstripped the others regarding safe load and price, which is the reason why these poles were adopted.

The standard poles are 23 ft. high to the lower insulators; the standard spacing is about 165 ft., the two parallel poles are spaced about 13 ft. apart. They are imbedded in concrete blocks about 5 ft. deep. Each pole is made up of two 5.5-in. I-beams; for present conductors 3.5-in. I-beams would have sufficed, but because in the future new plants will be put on the line heavier conductors were employed.

There are a total of 2260 towers, which were erected by two

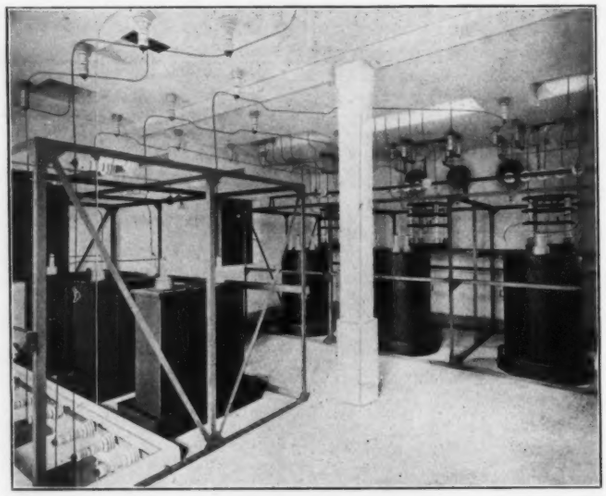


FIG. 8.—LIGHTNING ARRESTER EQUIPMENT, HIRSCHAU SUBSTATION.

gangs, each consisting of 40 men, capable of erecting, on the average, 20 towers per day. As nearly the whole course follows the river Isar, all of the material was conveniently transported on boats.

There are only a few special structures throughout the whole line. Wherever the transmission line crosses a telephone line higher poles are chosen, no guard or net wiring is employed. In one instance a special lattice girder construction was erected for crossing the State telephone system. The line crosses the Isar three times, and at these points special angle-iron lattice constructed towers are made use of to carry spans of 365 ft. For these spans, instead of copper, bronze conductors of 29 sq. mm were used. The poles are grounded by a 12-in. x 12-in. plate; all poles are interconnected electrically by an iron wire.

The whole line is transposed three times, thus dividing the line into four sections, to nullify the electrostatic and inductive effect on the telephone line. The last transposition brings the phase leads into their original position.

Midway between the power house and Munich, at Achering, there is a lightning-arrester station, through which the circuits pass. This station is divided up into two separate rooms, one for each circuit. Here are located three horn-gaps with 2-in. setting; they are 6 ft. apart, separated by double asbestos partitions. Each phase lead is connected to a 5000-ohm rheostat submerged in oil and then grounded by plates connected to the ground wires of the towers. Section switches are placed between the lines and horn-gaps, so that the latter can readily be cut out. Line section-switches are placed at intervals of 1 km in order to facilitate the localization of faults.

The four sections were watched by four patrolmen, each covering twice daily eight miles. After a quarter year of operation, it was found more economical to replace the four patrolmen by two men mounted on motor-cycles. When extra men are needed they are called in by telephone and arrive on motor-cycles.

The lightning-arrester station has two telephones, one for each transmission line. They are carried on the towers of the transmission line about 3.5 ft. below the lowest conductor. The telephone lines are transposed every 650 ft. to counterbalance any inductive effects.

SUBSTATION.

Energy is received at the end of the line at the Hirschau transformer station at about 48,000 volts, the e.m.f. being then transformed to 5000. The lines enter the substation with protection devices similar to those at the power house, and feed

into the two three-phase transformers. On the secondary side is a 5000-volt busbar system, arranged in two sections by sectionalizing switches. From here three connections are made to the already existing distributing system in the city of Munich.

The transformer station is seen in Fig. 6. The adjacent small building contains protecting apparatus for direct lightning strokes. The architecture of the buildings, particularly that of the larger one, is that of a south Bavarian farmhouse. It is built up of brick, to which stucco is applied. On the ground floor it contains the transformers, 5000-volt switching apparatus and water-flow grounders. On the second floor are the generator choke-coils, placed in oil; choke-coils and oil rheostats. On the upper floor, directly above the choke-coils, are the horn-gap arresters.

The transformers are of the Siemens-Schuckert type, similar to those installed in the power house. Each is located in a room separated by an inspection or repair room. They rest on rollers and tracks and can readily be moved.

The switchboard in the substation is also of the wagon panel

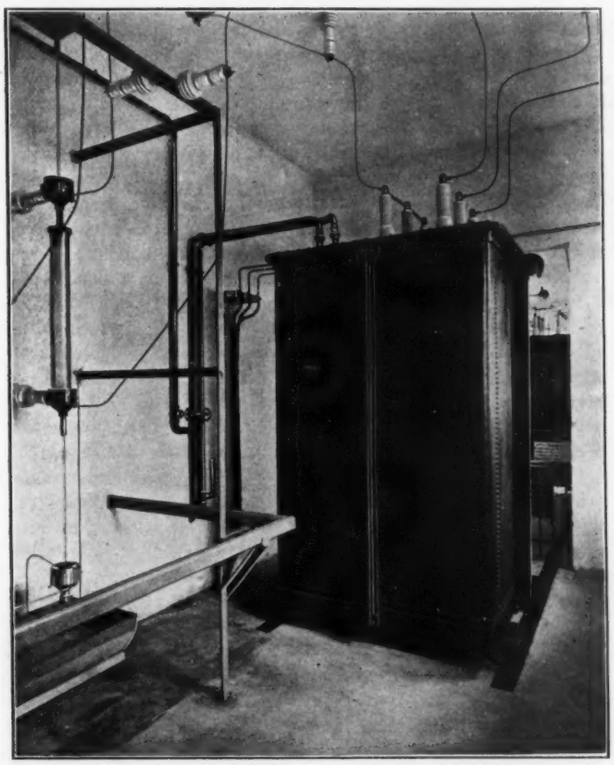


FIG. 9.—TRANSFORMER AND WATER FLOW GROUNDER, HIRSCHAU.

type of Siemens-Schuckert make. It is different from the previously described one in that the wagon is a whole panel running on tracks in the floor of the switching room. Each wagon contains an oil switch operated by hand, provided with an overload relay and one ammeter with its transformer.

There is a 7-kw, 5000-to-110-volt, three-phase transformer to supply energy for the operation of two centrifugal pumps, for circulating the cooling water of the transformers, and for water-flow grounders, rheostats, etc. This transformer also supplies energy to a 1-kw motor-generator set, assisted by a 30-volt battery of 81 amp-hour rating, to light the station.

The transformer station is connected to all stations and substations with which it runs in parallel by private and local telephones, and with the main generating station in three different ways. Two are the high-tension lines running beneath the 50,000-volt circuits and the other runs along the poles of the long distance State telephone, which is not influenced by high-tension lines.

Special precaution is taken with the high-tension telephones to guard against all possible danger. As stated, the 50,000-volt transmission lines are transposed twice, and the telephone line every 650 ft. This arrangement, however, was not considered perfect. The telephone line is carried on two-piece, three-petticoat insulators tested at 70,000 volts. The telephone is protected first by small horn-gap arresters, then high-pressure fuses grounded with small spark gaps; next by fine fuses known as "Bosepatronen," grounded by two carbon telephone lightning arresters. A variable water rheostat is shunted in ahead of the "Bosepatronen," and by adjusting the electrodes the buzzing effect of electrostatic induction is eliminated, thus giving good articulation.

It was thought unsafe to connect the line directly to the transmitter, therefore between the latter and the line is cut in a microphone-telephone, which is connected to the transmitter by pressed paper tubes. The receivers are connected to the telephone by flexible tubes.

Recent Central Station Developments at Hartford, Conn.

THE system of the Hartford Electric Light Company and the general commercial policy of the organization illustrate in a marked manner the progressive tendencies of modern central stations administered with a broad appreciation of the relations between a lighting and power service and the growth of a prosperous community. In a rapidly developing commercial center, a central station prepared to supply power in large and small quantities at reasonable rates can, by an alert commercial policy, do much to aid the general prosperity of the city which it serves. By providing for the best forms of lighting known to the art at rates within the reach of the average customer; by encouraging the use of current-consuming devices of all kinds in an organized way; and, first and last, maintaining a reliable service on all its circuits, such a company soon becomes an indispensable factor in the industrial life of its territory. These considerations apply with particular emphasis to the Hartford company, which has long been widely known in the central-station industry as one of the most enterprising organizations of its class in the United States.

The power system of the company represents a combination of steam and water facilities operated in a network serving the communities of Hartford, East Hartford, West Hartford, Wethersfield and Windsor. The total population of the territory served by the company is about 115,000 persons. The power load of the company consists of about 9000 hp in motors connected, in addition to which 1500 hp is used for railroad purposes. General commercial and street lighting is furnished by the company throughout practically all its territory.

The main generating station of the system is located at Dutch Point, on the Connecticut River, about 1.25 miles from the business center of the city of Hartford. This plant will shortly have a capacity at normal output of 7500 kw, generated by Westinghouse-Parsons turbo-alternators. Twelve miles away from Hartford on the northwest side of the city the company owns a water-power station called the Tariffville plant and having a normal capacity of 1500 kw. The company takes all the output of the Farmington River Power Company, which has a hydro-electric plant at Poquonock, Conn., the capacity being 1200 kw. The latter plant, which is known as the "Rainbow" station, is 12 miles north of Hartford on the Farmington River. This stream also is drawn upon by the Tariffville plant for water supply. All three of these generating plants are connected with a distributing substation at Pearl Street, Hartford, which is located practically at the center of the commercial district. There are no interconnecting lines between the different generating plants at present, other than the common connection at the Pearl Street busbars. The company operates substations at Ward, Belden and State Streets, in addition to the Pearl Street distributing station.

The Dutch Point plant has already been described in these columns, but a brief reference to its principal features will be made in outlining the general power system and the discussion of some recent improvements in the equipment. The boiler

equipment at Dutch Point consists of six 550-hp horizontal water-tube units, operated at 150-lb. steam pressure and 100 deg. Fahr. superheat, and two 1250-hp vertical water-tube boilers. All the boilers are equipped with superheaters. Outside the station is a coal-storage capacity of about 10,000 tons. Hand firing is employed at the plant and the Parsons blower system is in service. There are two steel chimneys, each being 10 ft. in diameter and 150 ft. in height. The fuel burned

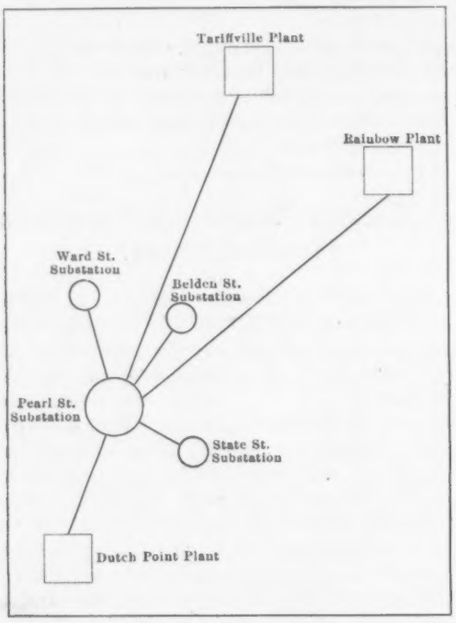


FIG. 1.—DIAGRAM OF PLANTS AND SUBSTATIONS.

is 70 per cent buckwheat and 30 per cent Westmoreland gas slack coal. Ordinarily one man is assigned to each horizontal boiler and two to each vertical boiler in service. The station is run upon three eight-hour shifts.

The steam plant at Dutch Point, as planned for immediate completion, consists of one 3500-kw, one 2000-kw and two 1000-kw Westinghouse-Parsons turbo-alternators, all the generators being 2400-volt, two-phase machines, with a frequency of 60 cycles. The condensing equipment is of the Alberger type, surface pattern. The 2000-kw turbine exhausts into a condenser of 8000 sq. ft. cooling surface. The two 1000-kw turbines deliver exhaust steam into a single condenser of 6000 sq. ft. cooling surface. The 3500-kw unit, when installed, will have two condensers of 6000 sq. ft. each. The reason for this is that the 3500-kw set replaces a 1500-kw turbine which was installed with the original equipment in 1904, a condenser of 6000 sq. ft. being provided. The vertical boilers were set up in 1907. The circulating water for the plant is drawn from the Connecticut River by four Alberger centrifugal pumps direct-connected to 50-hp, 250-volt, two-phase Westinghouse induction motors. There are two 8-in. x 18-in. x 18-in. x 24-in. Alberger two-stage dry-air pumps and a Worthington single-acting pump. Either Alberger pump is capable of handling the existing installation. In each condensing set is a hot-well pump with 6-in. x 6-in. x 6-in. cylinders. The exciter equipment of the plant consists of one 75-kw, 125-volt unit driven by a Curtis turbine, and two Westinghouse 50-kw generators, each driven by a 10-in. x 12-in. Chandler & Taylor engine.

The operation of the Dutch Point plant at its full capacity requires 20 men on the fireroom payroll and six men in the engine room and on switchboard work for the three shifts. The plant is connected with the Pearl Street substation by one two-phase, 2400-volt line of 500,000 circ. mil cable and two two-phase, 2400-volt, 250,000-circ. mil lines, the distance being 6533 ft. From this station at Dutch Point two-phase commercial 2400-volt lighting and power service is also distributed, and a three-phase, 11,000-volt line 12.5 miles long supplies current to New Britain. The original switchboard of the plant was equipped with hand-operated oil switches of the lever type. The company recently decided to install a remote-control electrically operated switchboard in place of the first one, and this work is now being carried out. In the new arrangement the busbars are carried on a bus structure behind the operating switchboard, a new gallery having been built out of the station to provide for this. Busbars are so arranged in their respective compartments that one leg of each phase is located on the same side of the bus structure, while the two opposite legs are located on its reverse side. This arrangement avoids a condition of maximum voltage between adjacent buses. The rear of the bus structure faces a broad expanse of window space with admirable natural lighting, and all switches and current transformers are provided with disconnecting knife switches to render inspection and repairs perfectly safe. Below the bus and switch structure is located a compartment for the installation of feeder regulators and the generator rheostats. The first installation of feeder regulators will be of the General Electric B. R. type. The regulators are designed to control the voltage of the circuits within 7.5 per cent above and below normal. Below the regulator compartment is a transformer and cable vault. A Tirrill regulator is installed in the new layout. Westinghouse oil switches are used in the new arrangement. Three bus sections will be installed in the new structure to provide sufficient operating flexibility. In the lowest section of the switchboard room extension are installed three 500-kw oil-cooled transformers for the New Britain service. These are provided with tracks leading to a car which can be run out of the transformer section on rails in case of any trouble, to a hatchway served by a crane, which will hoist the transformer outside the building. The transformer room is ventilated by a fan driven by a 5-hp motor. The transformer oil is pumped through a closed circuit of piping or cooling coils immersed in the river water from a storage tank, the latter having overflow connections from the transformer cases.

The Dutch Point station was designed, built and equipped by Westinghouse, Church, Kerr & Company.

The Tariffville plant was started in 1900. It operates under a hydraulic head of 34 ft. All the machinery is direct-connected. There are two pairs of 48-in. horizontal Victor turbines with draft tubes, each pair operating a 750-kw, two-phase

FIG. 2.—EXHIBITION DEPARTMENT.

Westinghouse alternator wound for 500-volt, 60-cycle current. Four transformers raise the potential to 10,000 volts, three-phase, for transmission to Pearl Street over a No. 0000 copper equivalent aluminum line 11.3 miles long. This station is operated in three shifts, six men being on the payroll.

The Rainbow plant, owned by the Farmington River Power Company, is provided with Rodney Hunt and McCormick wheels driving by shafting and belts two 600-kw, two-phase, 500-volt

alternators. Current is transmitted to Pearl Street over a line consisting of two three-phase No. 0 circuits, this size being carried as far as a terminal house in the suburbs, where the transmission at 10,000 volts is carried underground to Pearl Street in a three-conductor No. 4-0 cable.

The principal equipment of the Pearl Street substation is a 250-kw and two 400-kw rotary converters for 250-volt service, three-wire direct-current lighting in the business district, with the necessary transformers and switchboard equipment. A number of commercial alternating circuits also branch out from this substation. Pearl Street is connected with the State Street substation by three two-phase tie lines, 2400-volt, No. 0 copper about 0.6 mile long. At the latter substation are one 500-, one 250- and one 300-kw rotaries for three-wire direct-current service, commercial alternating-current service panels on the switchboard, tub transformers for street lighting, and a storage battery of 17000 amp-hours capacity at 250 volts for lighting service. Six men each are required on the operating payrolls of the Pearl and State Street substations. No regular attendance is

FIG. 3.—ELECTRIC RANGE.

required at either the Ward or Belden Street substations, both being for street-lighting distribution only, with recording ammeters in each plant, one per circuit. Patrolmen on their rounds visit these substations regularly. There are four tub transformers at Belden Street and five at Ward Street. At present there are 806 arcs of the enclosed type and 225 series incandescent street lamps in Hartford.

In the accompanying diagrams typical load curves are reproduced for a recent Saturday, Sunday and Tuesday, showing the total output of the various plants. The influence of the power load is most striking on Tuesday (representative of week days of continuous work), and also on Saturday morning. The maximum load is held well throughout the working day, and the resulting load factor is far better than under the old central-station condition of a very small power load, typified by the Sunday curve. The large proportion of the total energy that passes through the Pearl Street substation is clearly shown by the curves. On Sunday all the load for a considerable portion of the day is handled through this station. It is clear that the lighting load cuts much less figure in relation to system capacity than does the power load. On the average week day, from about 7 a. m. to 5 p. m., the load approaches closely to ideal conditions, except for the necessary shutdown at the noon hour. No better example of the value of a day motor load could be desired.

In the commercial field the company has been no less active than in technical matters. The executive offices are located at 266 Pearl Street, but an exhibition department is located in an attractive store at 575 Main Street, and in the latter place is displayed a varied assortment of equipment, largely for domes-

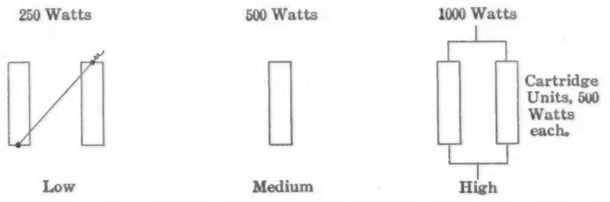


FIG. 4.—CONNECTIONS FOR LOW, MEDIUM AND HIGH HEATS FOR ELECTRIC RANGE.

tic service. This department is open from 8:30 to 5:30 on week days, and it has three rooms for apparatus display, with provision for demonstration purposes. Electric cooking, heating and lighting apparatus are shown in the outer room, with special shades, and there is an arrangement of six electric meters with variable loads whereby customers can be shown the effect of turning on or off different numbers of lamps or other apparatus. A flat-rate controller is also exhibited here. The inner room is more particularly devoted to electric heating and cooking appliances and their demonstration.

At the executive office a flat-rate controller is exhibited. with 25 incandescent lamps mounted in a panel above the cashier's counter. The controller is adjustable to cut off current according to its setting from 1 to 12 lamps, having a range of from 50 to 600 watts for demonstration purposes. The company favors selling current for lighting on a flat rate with a limiting device to prevent the use of more than the agreed number of lamps at any one time, and the controllers are naturally considered an important feature to make clear to the customer that this point has been reached. When this predetermined limit has been attained the lights are flashed, instead of throwing

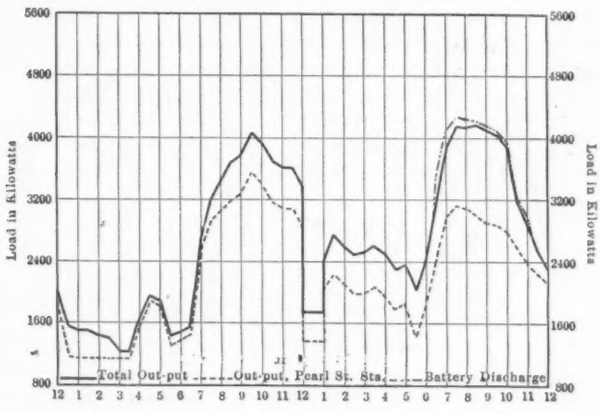


FIG. 5.—LOAD CURVE, SATURDAY, SEPT. 5, 1908.

the installation into darkness and thereby annoying the customer needlessly. The office on Main Street handles the commercial end of the residential lighting, sells all apparatus displayed and demonstrated, and receives payments for all service. The power problems are handled at Pearl Street, and bills are likewise receipted there, renewals taken care of, etc. In the last two years the company has put out a large number of electric flatirons, about 1100 being on the circuits. The company handles 3-lb. and 6-lb. irons, selling them for $3.50 each. At times special campaigns have been made on a two weeks' free trial, with occasional advertising in the daily press. Irons

have been placed in domestic service, hotels, tailoring establishments, dressmaking concerns, etc.

The company has paid unusual attention to the problems of electric heating, and has thus far been very successful in this field. Mr. A. C. Dunham, president, has developed a number of novel forms of heating apparatus which the company is introducing, notably an electric range, illustrated in the accompanying engraving, an electric radiator, and a special hot-water equipment for use in ordinary kitchen tanks and boilers. About 50 of these ranges have been installed in Hartford so far. The

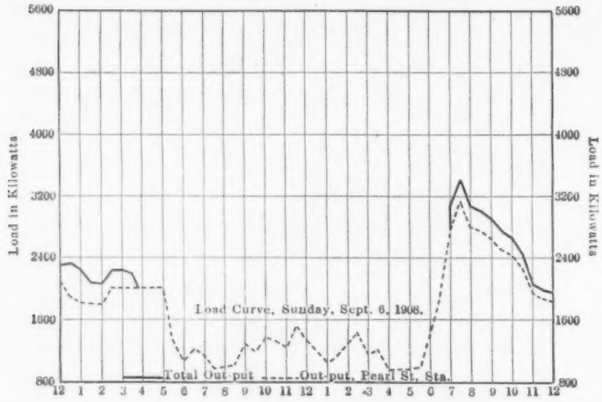


FIG. 6.—LOAD CURVE, SUNDAY, SEPT. 6, 1908.

range is 34 in. high, 24 in. deep and 36 in. long. It is provided with two stoves set into the top and an oven, with controlling switches on the front. G. E. 500-watt cartridge heaters are used. In the left-hand stove are two cartridge units; in the right-hand stove there is a single unit, while the oven has four units, one pair being located on each side of the center, at the bottom. Three heats are provided, secured by series or parallel combinations of the cartridge units. Two 2-cp pilot lamps are provided with the ranges, so that when any part is used these lamps are lighted. The oven is 16 in. x 16 in. x 23 in. in dimensions inside, and is provided with an aluminum reflector at the top, to throw back the heat upon the upper portions of anything which may be baking, and prevent burning. The Hartford Electric Light Company makes the range and assembles it. It is operated on 110-volt circuits, either alternating or direct. The company sells these ranges at $40 each connected and ready for service, with a broiler, cooker and roaster of tried quality. The rates for electric cooking are 4 cents per kw-hour by meter, or, on a contract basis, which the company favors, $1 per person per month, 50 cents per person per month being charged for children under six years of age. The second method of charging has been found to work out very satisfactorily.

A new departure of the company in the commercial line is the fitting of a complete modern flat with electrical devices applicable to domestic use, for exhibition purposes. This flat is located near the Pearl Street office in an old church property which the company owns, and is now being equipped and furnished. The frontage is on Asylum Street, in the business district, and the flat has two hallways, a parlor, chamber, dining room, bath and kitchen. The pantry is eliminated by cabinets in the kitchen. No coal, gas or kerosene will be admitted to the flat, and there is no provision for any but electric heating and cooking. There will be distribution cabinets in the side hall for heating and lighting, and special illumination of the best modern character will be installed. It is proposed to light the dining room with four tungsten lamps, probably locating them in the upper corners of the ceiling behind screens of some kind, and in front of reflectors which will give a soft, mellow light for the table.

The kitchen will exhibit one of the ranges previously described, and other apparatus useful in domestic service. The kitchen tank water-heater is already in place and this consists, in brief, of a 250-watt heating coil located in a small tank above the ordinary 40-gal. boiler, with an automatic switch to cut the current in or out, according to the water pressure on the tank; in the bottom of the boiler is another 100-watt coil to keep the larger body of water warm. In the small upper tank the water is practically brought to the boiling point by the coil; in the boiler proper it is held under storage at a reasonably high temperature for service. A float is provided to start and stop the flow into the boiler, and the coils are wired to wall plugs with flexible conductors. The equipment runs here on 110-volt alternating current. There will be outlets for flatirons, chafing dishes, shaving cups and other devices. The heating of the flat will be accomplished with the combination electric and hot-water radiator which Mr. Dunham is developing. In the form thus far made it consists of a vertical corrugated stand of water ducts or coils in which are disposed heating coils of about 1000 watts capacity. The success of this arrangement seems to be reasonably established, and its improvement in mechanical details to cheapen the construction cost is now under way. Last winter one of these radiator installations was located in a tailoring establishment at a cost to the proprietor of $10 per month. The shop was 16 ft. wide and 43 ft. long, and was heated successfully all winter at the reasonable cost indicated. The shop was the only one on the street in zero weather which did not have frosty windows. The company is hoping to make this device specially successful in heating rooms that are at the present time difficult to warm, and there are many such in Hartford. If the load develops later along this line it will prove helpful in increasing the night load curve, and therefore the general load factor.

The following careful tests have been made of the current consumption and cost of cooking on the electric range:

1. Dinner cooked in Toledo cooker on 500-watt stove (smallest size).—4.25 lb. corned beef (boiling four hours); potatoes, beets, cabbage, cup custards; no intermingling odors. Total kw-hours, 2.24. Cost for five people, 8.9 cents.

2. Dinner for eight persons.—Four pounds corned beef, 3 lb. cabbage, potatoes, carrots, parsnips, turnips, two large loaves brown bread, two fruit puddings, all in Toledo cooker; in oven, two large apple pies, four dozen biscuit, one dozen raised biscuit. Total kw-hours, 6.04; cost, 24.1 cents.

3. Dinner for five persons.—Beefsteak, 4.5 lb. sirloin, broiled; potatoes, macaroni, cheese, crackers, eggs, coffee. Total kw-hours, 2; cost, 8 cents.

4. Dinner for six persons.—Roast pork. 4⅛ lb., potatoes, tur-

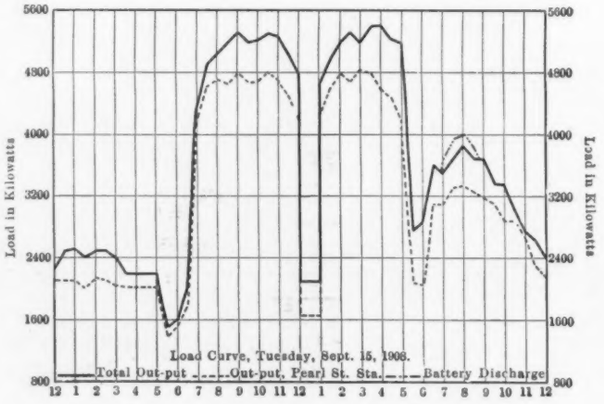


FIG. 7.—LOAD CURVE, TUESDAY, SEPT. 15, 1908.

nips, fried apples, two apple pies, coffee, three loaves bread. Total kw-hours, 6.15; cost, 24.6 cents.

In its power business the company has succeeded in displacing a large number of inefficient steam and gas engines with electric motors, and is operating numerous factories. The company believes firmly in the policy of encouraging long-hour business, and would much prefer to receive 30 cents for a kw-day of 24 hours at a rate of 1.25 cents per kw-hour than a rate of 30 cents per kw-hour for a single hour. The power rates on a basis of use of nine hours per day are from 1.65 cents per kw-

hour down to 1.5 cents in large quantities. For 24-hour use the rate is 1.25 cents per kw-hour. These consumptions are all metered.

For residence lighting the company favors a flat rate with a limit to the number of lamps in service at any time, as outlined above. It makes the proposition to install and supply five 25-watt tungsten lamps for a residence at a cost of 35 cents each per month, and charges 30 cents each per month for all lamps above five in number. The lamps are supplied free to the customer, and renewed free. For 40-watt tungsten lamps the charge for residential service is 40 cents each net per month per lamp. The current alone is charged for in this proposition. The company fills other sockets in the house with other lamps of equivalent wattage. This rate was put in force in the summer of 1908, and in the opinion of the company counts strongly with the customer who has become accustomed to free lamp renewals, while insuring an adequate revenue. Incandescent store lighting rates at Hartford run from 11 cents per kw-hour downward. The company is making some experiments with a 10-cp 12.5-watt tungsten lamp built for 28 volts with the hope of introducing it in residence lighting. In street-lighting service a large number of series tungstens have been giving excellent satisfaction.

The officers of the company are: President, Mr. A. C. Dunham; vice-president, Mr. S. G. Dunham; treasurer, Mr. D. Newton Barney; assistant treasurer, Mr. Curtis C. Cook; general manager, Mr. Robert W. Rollins; superintendent, Mr. E. F. Lawton; assistant superintendent, Mr. Charles Yale.

Non-Harmonic Alternating Currents.

BY DR. BENJ. F. BAILEY.

A vast amount of work has been done upon the subject of alternating currents, and practically every author assumes the waves of current and e.m.f. to be sine waves. This is, of course, entirely proper since the sine wave of e.m.f. is generally recognized as the best for all around use, and the mathematical difficulties of any general treatment would be prohibitive. It is, however, a well-known fact that in practice, e.m.f. waves frequently differ greatly from the sine form. This is especially true in alternators having concentrated windings and in rotary converters.

As an example, in the Laboratory of Electrical Engineering of the University of Michigan we have available alternating current from eight machines. Only two of these have e.m.f. waves of approximately a sine form. The remainder differ so greatly from the standard form and from one another that it is possible to recognize any one of them instantly from its e.m.f. wave. These machines are of various ages, from one to 20 years, the oldest giving the nearest approach to a sine wave, a home-made machine being the next best, while two standard commercial machines, built within the last two years, differ very widely from it. In view of these facts it may be well to examine briefly what happens in circuits of various kinds subjected to non-harmonic waves of e.m.f.

It is a well-known fact that any periodic function, no matter how complicated its form, may be represented by a Fourier's series, representing analytically the superposition of a number of sine waves of various amplitudes and phase differences. In the case of alternating currents, the positive and negative sides of the waves are, in general, alike. Under these circumstances it is obvious that all the even terms of the Fourier equation drop out.

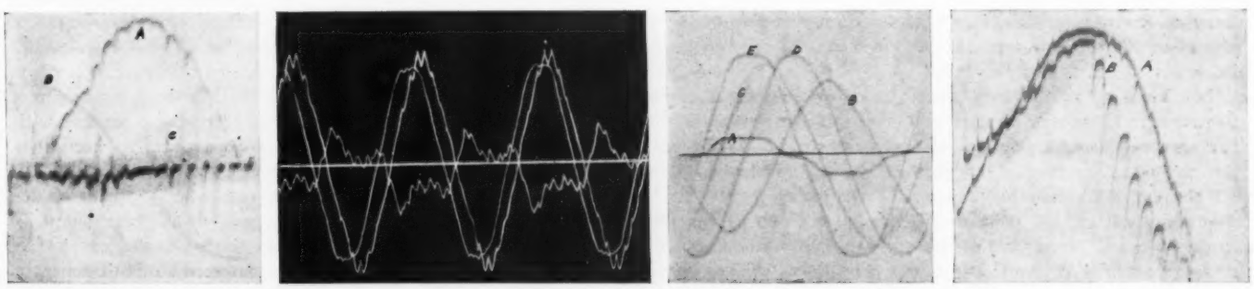
Prof. Thompson and others have given simple rules for determining the components of a wave of given shape. Having by some such method resolved a wave into its component sine waves, we may determine the effect of it upon any circuit by considering the component waves separately; that is, we may compute the current due to each harmonic separately and by adding them in proper phase relation, may obtain the current that will flow under the given conditions.

In a circuit containing inductance alone, the current will be given by $I = \frac{E}{2\pi n L}$, where E is the virtual applied e.m.f., L is the coefficient of self-induction, and n is the frequency. To get the resultant current through an inductance, we must obtain the E and n for each of the component wages, compute the corresponding values of I and add them in proper phase relation. It is readily seen that the third harmonic will be only one-third as effective as the first in forcing current through the inductance; the fifth will have only one-fifth the effect, and so on. Thus, all the higher harmonics will be strongly damped and the resulting wave of current will be much nearer a sine wave than was the applied e.m.f. wave.

Fig. 1 shows this very clearly. A is the curve of e.m.f. It has a quite pronounced twenty-seventh harmonic, besides others of a still higher order. B is the curve of current through a shunt-field coil without iron, used as an inductance. The curve, as will be seen, is very nearly of the sine form and the prominent twenty-seventh harmonic can hardly be detected. The current, of course, lags almost 90 deg. behind the e.m.f.

The above must be somewhat modified when the inductance contains iron. This is due to the fact that the magnetization curve of iron is not a straight line; or, stated differently, the inductance is not constant for varying currents. Thus, even a sine wave of e.m.f. will produce a distorted wave of current.

The reverse of this is sometimes of considerable importance. In applying a breakdown test to electrical apparatus, it is the practice of some engineers to regulate the applied voltage by means of a resistance in the primary of the testing transformer. If the machine e.m.f. is sinusoidal, and the resistance used is great enough to absorb most of this e.m.f., the resulting current will be nearly sinusoidal. The resulting flux curve will, however, be of a distorted shape due to hysteresis and saturation of the iron, and the secondary e.m.f. wave will consequently not be of the sine form. As a consequence, the peak of the wave may be a great deal more or less than 1.41 times greater than the virtual voltage as read on a voltmeter, and the test is not a fair one. The remedy is, of course, to connect the transformer directly to the test alternator and regulate by varying the field current of the alternator.



FIGS. 1, 2, 3 AND 4.—CURVES OF NON-HARMONIC ALTERNATING CURRENTS.

In a capacity, the conditions in regard to distortion are the reverse of those present in an inductance. The current is directly proportional to the frequency, being given by the equation $I = 2\pi n E C$. Hence, the harmonics are all magnified in

direct proportion to their frequency. Thus, a small thirteenth harmonic will be magnified 13 times and may readily attain a greater amplitude than the fundamental. We are very liable to get a current wave so distorted that it even crosses the zero axis a great number of times in each wave.

We may avoid using a Fourier's series by looking at the subject from a slightly different way. The current is given at any instant by $i=\frac{dq}{dt}$. Since in a condenser $q=ce$, $i=\frac{dq}{dt}=c\frac{de}{dt}$. If now we draw the curve of e.m.f., $\frac{de}{dt}$ is the tangent at any point. This becomes zero wherever the curve becomes horizontal. Hence, if the curve is sufficiently distorted so that it becomes parallel to the axis at several points, the current will have zero value at each of these points. If hollows occur, the current will have negative values for each of them. In Fig. 1, *c* is the curve of current in a condenser. The three curves were taken simultaneously, the same applied e.m.f. being used for the two current curves. It will be seen at once that the condenser current is very much distorted, the twenty-seventh harmonic now being very prominent. The current as a whole leads the e.m.f. by 90 deg.

Every long transmission line, and to a still greater extent, every underground cable, has considerable capacity. The charging current which is very considerable for long lines at high voltages, is, in general, of a very distorted form. The higher harmonics may in certain cases cause resonance effects and lead to abnormal rises in voltage.

A very curious case occurs when a discharged condenser is suddenly connected to a line, especially if the e.m.f. is near the peak. The condenser, being without charge, can, for the instant, exert no back e.m.f. The effect is consequently the same as a short-circuit, but lasts only for an instant, until the condenser can charge. This sudden rush of current generally occurs when an empty transmission line is switched onto the busbars, and in some cases a very excessive momentary current may be drawn from the circuit.

One of the most interesting effects of distorted waves is in connection with the synchronous motor or with alternators in parallel. In almost every article or discussion it is assumed as one of the advantages of the synchronous motor over the induction motor, that its power factor can be made unity and it is also assumed that a number of alternators, operating in parallel upon a given load, may have their power factor made alike and equal to that of the load by a proper adjustment of their field currents. This is by no means always the case, and it is a fact that there are many synchronous motors in operation whose power factors, even with the best adjustment of their field current, is considerably worse than would be that of an induction motor on the same circuit. Unity power factor can be obtained only when the wave of applied e.m.f. and that of the synchronous motor are of the same shape.

That this is so can be readily seen when we consider that the effective e.m.f. driving the current through the motor is the difference between the applied and the back e.m.f. Taking two such curves as the two larger ones of Fig. 2, it is readily seen that the curve of difference of e.m.f. will differ greatly from either of them. This unbalanced e.m.f. will force current through a circuit consisting of the resistance and inductance of the machines and transmission lines. The more peaked curve of Fig. 3 is that of a two-phase alternator, and the other that of a two-phase rotary converter of the same capacity. Both, I would point out, are modern machines, less than two years old; *c* of Fig. 3 shows the current circulating between them. The field of the rotary was adjusted for minimum armature current, and the rotary was unloaded. This curve of current is not so distorted as the curve of the difference of the e.m.f. since the inductance of the circuit tends to smooth out the fluctuations, as already explained. The curves of Fig. 3 were not taken simultaneously, so the phase angles are meaningless. The power factor was 0.5, and this was the best obtainable with no-load. A power-factor meter connected in circuit would, of course, show unity. As far as the writer is aware, these instruments are all defective in that they indicate the cosine of the average angle of lag or lead instead of the real power factor, or the ratio of the true to the apparent watts.

An increase of load improves the power factor, but with the above machines it is impossible to obtain exactly unity power factor with any load and any field current.

ROTARY CONVERTERS.

It is frequently very difficult to obtain true sine waves of e.m.f. from a rotary converter. This is especially true if the same general design is used as a three-, four- or six-ring converter. It will be seen that with a uniform air-gap, a single conductor generates a flat-top wave of e.m.f., the flat portion being of about the same angular width as the polar angle. There will also be a considerable interval during which the e.m.f. will be nearly zero. The angular width of this will be somewhat less than the polar gap.

In a rotary converter we connect several such conductors in series and the resultant e.m.f. wave is the sum of the individual waves added in their proper phase relation. The curves of Fig. 3 are e.m.f. curves from a small rotary converter. This machine is provided with six rings for operation either as a two- or as a three-phase machine. Curve *A* is that given by a band of conductors 30 electrical degrees wide. The band in *B* was 60 deg. wide; in *C*, 90 deg; in *D*, 120 deg., and in *E*, 180 deg. They correspond, respectively, to a 12-, six-, four-, three- and two-phase connection. It will be noticed that a flat-top wave is produced when the angle subtended by the winding is either greater or less than the polar width. The reason for this will be obvious if we consider that since with a band wider than the pole, the armature may be a considerable distance either side of the maximum e.m.f. position and still have all the flux cut in the same direction by the conductors. With a narrow band of conductors a considerable movement each side of the maximum e.m.f. position may take place without moving the band from beneath the pole.

FIG. 5.—DIAGRAMS OF CONNECTIONS OF ROTARIES TO TRANSFORMERS.

The above has a direct application to the connection of quarter-phase and six-phase rotaries. Thus, a six-phase machine may be connected to its three transformers by either a diametrical or a double-delta or a delta connection, as shown in Fig. 5. The rotary under consideration would give the curve *E*, Fig. 3, with the diametrical connection *D* with the double-delta, and *B* with the delta connection. In this case it is obvious that the double-delta would give the nearest approach to a sine wave and hence would be preferable, at least for use with a generator giving a sine wave. The diametrical connection is the next best in this respect, and the delta, the worst of all. It is thought that this will almost invariably be the order of desirability of these three connections, so far as wave shape is concerned. The same considerations apply in the case of a quarter-phase rotary, which may be connected so as to generate the wave *C* or the wave *E*.

There is another way in which the e.m.f. wave of a rotary converter may undergo variations. Most converters have a comparatively weak field and the current in the coil under commutation by the direct-current brushes may have a decided magnetic action on the field. In Fig. 4 are shown two e.m.f. curves from the same rotary. In *A* the brushes are normal and in *B* they are rocked backward. The brush displacement was not enough to make the machine spark. The sharp peaks are very noticeable and the number per wave is the same as the number of commutator bars per pair of poles. This machine has metallic brushes, and undoubtedly the effect would be less with carbon brushes.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Ten Thousand Loaned Irons in Chicago.

The Commonwealth Edison Company, Chicago, is soon to begin a campaign for introducing household utensils on a scale that has never before been tried out by any company supplying current for commercial purposes. The company has recently purchased 10,000 electric flatirons, which it will distribute among its consumers of current. The plan whereby these irons will be introduced does not involve any unusual demands on the consumer. The irons will be placed in the hands of the reliable customers throughout the city, subject to the condition that the irons may be recalled by the company after a period of six months.

Whether or not they will be recalled at that time depends upon the success or failure of the venture to increase the current consumption by those having the irons in use.

Peculiar Lighting Situation in West Springfield, Mass.

On account of the adoption of a policy of semi-municipal ownership by the town of West Springfield, Mass., in connection with the distribution of electricity in that community by the United Electric Light Company, of Springfield, a somewhat unusual condition exists at the present time in relation to the circumstances under which service is supplied. About 15 years ago the town had a small water power which it was thought might some day be developed for lighting and power purposes, and out of this arose an idea on the part of the authorities that at some future time it might be the policy of the town to adopt municipal ownership. The money required to develop the water power has never been forthcoming, however, and the service has been supplied from the plants of the United Electric Light Company. The town purchased its water system some 15 years ago at what was considered to be a high price from a private company, and it is probable that this circumstance contributed to the attitude of the authorities of that time in relation to electrical matters. The town took possession of the poles and wires, and, in fact, erected all additions to the main supply circuits as the years passed and business developed.

Under the terms of the latest contract, the company pays the town 10 per cent of its gross receipts in the town for commercial lighting. The town owns the distribution circuits and pole lines and takes this money as a rental for the use of the overhead system. There are now about 400 customers in the town, which has a population of about 9000. There is no power business of any consequence. The revenue derived by West Springfield from the use of the distribution circuits by the company amounts to about $480 per year, which represents a net return of about 4.5 per cent on the first cost of the lines. The street-lighting load consists of about 400 40-cp carbon lamps and 50 direct-current arcs. The company feeds the West Springfield circuits by lines crossing the Connecticut River by bridge, the distance from the plant to the center of distribution being about one mile. The territory served extends, however, to points about five miles from the station on the north and west. The company maintains the line with the exception of the poles, and provides an inspector of the street-lighting system each and every night, as well as regular trouble wagon service from its main offices on State Street, Springfield, which is accorded to the West Springfield community as readily as to any other part of the system. This service is available 24 hours per day.

By the terms of the contract last made, which expires the coming spring, the town pays $73 per year for each street arc and $15 for each incandescent, all being supplied on all-night and every-night service. The rates are the same as in Springfield, and follow those exactly, and reductions in effect in Springfield have been carried into effect in the same way and at the same time in West Springfield.

From the standpoint of residents desiring service, the arrangement has proved difficult and annoying on account of the fact that extensions of service have been made by the town itself in its capacity as owner of the feeder circuits. If a tenant somewhat isolated from the highway wishes to install electricity, he cannot do so unless the town is willing to carry the feeder circuit past his door. This it has often been unwilling, slow or unable to do, which is directly in contrast with the policy of the United Electric Light Company in seeking new business. Extensions of the system when made have been carried out by contractors. On account of these difficulties the company has been unfairly blamed for not extending its main circuits to desirable consumers, whereas the trouble has been and still is that the circuits are owned and erected by the town, and the company has not the authority to extend them.

The company supplies each consumer with a transformer, which it owns, and a lead from the transformer to the house, which belongs to the company if run overhead and to the customer if run underground. The customer owns the inside wiring and the house attachments. If the lead runs underground the customer is usually charged 25 cents per foot, while if it is run overhead the charge varies from $3 to $4, according to the circumstances. The company supplies and owns the meter as well as the transformer. The original inside wiring is installed by a contractor, but the company supervises its operation here as elsewhere on its system. The average size of transformers in this part of the territory is about 1 kw. The company pays a yearly capitalization tax on the transformers and overhead leads to the residences and stores, and on account of the character of construction, and especially the practice of the town in running all sorts of fire, police, telephone and street railway feeder circuits on the same poles, it has been necessary for safety to operate the West Springfield lines at the antiquated potential of 1200 volts, necessitating a greater loss to the company in transmission and distribution, and requiring the investment in a separate special switchboard panel in the generating plant, with other disadvantages of dissimilar voltages on the circuits.

It was unfairly stated in a recent newspaper article about the West Springfield situation that the company has not attempted to secure new business in this territory, but the company has in reality had solicitors on the ground many times, and the only reason why it has found it hard to secure new business is the difficulty many customers have had in getting the town to run its mains within their reach. The advertisements of the company, the conveniences and hints of its main office, and all the resources of its system, with three power plants aggregating 12,000 kw, and 150 employees, are at the service of the West Springfield residents as well as any others. This community shared with the rest in a reduction from a rate of 18 to 15 cents per kw-hour for commercial lighting recently. The company would prefer to sell the town electricity and let it take care of the distribution and marketing, as is practised by the Boston Edison Company and some of its larger customers among the municipalities of eastern Massachusetts. The present arrangement illustrates how much less sensitive is a municipality than a private company to the various needs of its customers.

Under municipal or semi-municipal ownership, the wants of the individual tend to be overlooked, as they are not in a private enterprise, and the municipality rarely, if ever, keeps abreast of the times, but instead runs along behind the best practice

and most effective initiative. Corporate ownership anticipates these wants where there is a change of obtaining a new customer. Taken altogether, the plan has not been a salutary one for West Springfield. It has deprived the people of the use of electricity to the extent desired, and with only a partial control, as the local government has never had a department to look after the service. The situation as a whole illustrates the advantage of single control, and it is probable that at some future time a readjustment will be made more in harmony with the best interests of the company and its patrons in this community.

Isolated Power Plant Costs and Their Relation to Central Station Service.

By W. F. Lloyd.

In analyzing isolated power plant operating costs it is found that there are always two main divisions to be considered, namely, the fixed or constant charges, and the variable or generating charges.

The first division for a given plant covers a certain fixed sum per annum, independent of the output of the plant, and is therefore not affected by any increase or decrease in the hp-hours generated. The items generally involved in the fixed or constant charges are as follows:

Interest upon investment at 5 per cent, depreciation upon equipment at 6 per cent, taxes and insurance at 2 per cent, value of space occupied by plant, labor, water rent, oil and waste, repairs and miscellaneous expenses.

While the gross sum per year represented by this division is not affected by output, it has a very vital effect upon the cost per hp-hour of energy generated by the plant. In order to determine what proportion of the gross rate per hp-hour is represented in these fixed charges it is necessary that this gross sum be divided by the hp-hours generated during the year. It is, therefore, apparent that the greater the number of hp-hours generated, the less the cost per unit becomes.

The items involved in the variable charges are fuel and removal of ashes. These items are distinctly an output charge, the gross figure per annum varying in proportion to the hp-hours generated by the plant. It therefore becomes a certain figure per hp-hour output, the rate remaining the same at all load factors.

By dividing the constant charge of $2,200 by the value 122,400 the constant charge per hp-hour is found to be 1.8 cents. Dividing $1,225 by the same figure of 122,400 shows a value of 1 cent per hp-hour for the variable charge. Combining the constant charge and the variable charge rates at the gross rate per indicated hp-hour at the above load factor is found to be 2.8 cents and the gross cost per year is $68.50 per rated horse-power of capacity.

It is well now to investigate the effect of reducing the average load or load factor upon the gross rate per hp-hour. The constant charge of $2,200 remains the same independent of the average load. The gross variable charge varies as the average load or output in hp-hours; this item represents a cost of 1 cent for every hp-hour generated.

Assume, now, that the equipment is operating under an average load of 20 hp or at a load factor of 40 per cent, which is a very fair average for general manufacturing operations, a load factor of 80 per cent being seldom reached, except in the textile trade, flour mills, or refrigeration machine operation. A 20-hp average over 3060 hours per annum would show an annual output of 61,200 hp-hours. Dividing the constant charge of $2,200 by 61,200 the constant charge rate at this load factor is found to be 3.6 cents per hp-hour. To this figure must be added the variable charge rate of 1 per cent resulting in a gross rate of 4.6 cents per hp-hour and a gross cost per year of $56.24 per rated hp of capacity.

The above analysis emphasizes the well-known fact that in the operation of any power plant, decreasing the average load or output results in increasing the cost per hp-hour and in decreasing the total annual cost per rated horse-power.

It is apparent that the gross rate or total cost per hp-hour generated is represented by the sum of the fixed charge rate and the variable charge rate per hp-hour. Owing to the influence of the fixed charge rate, the total rate per hp-hour decreases as the output or load factor increases.

In order to emphasize the above considerations it is well to apply them to a specific example. Assume, therefore, a plant rated at 50 hp upon which there is a constant charge of $2,200 per annum, and a variable charge amounting to $1,225 per annum. Assume also that an indicator shows that the engine has been developing an average load of 40 hp. The plant is operated 3060 hp-hours per annum, which would result in a plant output of 122,400 indicated hp-hours per annum. The load factor is 80 per cent, although the full output of 50 hp is required at short intervals to take care of the maximum demand.

The above analysis will show the necessity of determining the maximum and average load before attempting to analyze plant costs or to prepare a central station proposition.

Invariably the first question that a prospective customer asks is, "How much do you charge for service?" This question will probably be accompanied with the statement that he has a 100-hp engine fully loaded and operating his mill for 60 hours per week, and will wish figures for 100 hp 60 hours per week, 51 weeks per year.

As the plant is probably actually operating at an average load of between 30 and 80 per cent of the maximum required, it is apparent that should one divide the total plant cost by the estimate of 306,000 hp-hours, the resulting figure would be considerably below any rate that the central station could offer. The central station man should, therefore, reply as follows: "The power required to drive your mill will probably average considerably less than 100 hp with the economies that can be effected with a properly arranged motor equipment and the elimination of a lot of heavy shafting and belting. As all central station energy is metered, it is essential to determine the average load in order to make an intelligent proposition. All that is asked is permission to test the engine and secure the data necessary to determine the probable consumption of energy in the event of the installation of motor drives. Doubtless then, a proposition can be made that will be to your advantage to accept." If the prospective customer is a fair-minded business man, the logic of this line of talk will appeal to him, and probably permission will be obtained to make a complete investigation of his plant.

It has been found to be a good policy in discussing the motor question with a prospective customer to avoid discussing rates, particularly during the early stages of the investigation, because scarcely one mill operator in a hundred knows at what rate energy is being produced in his plant.

In some cases, particularly where the equipment involved is not large, where average conditions exist, and where close estimating is apparently not necessary, it has been found advisable to quote figures on the basis of approximate charges per year per horse-power of equipment necessary to operate the machinery, having previously determined the average load factor applicable to that particular class of business. This method of quoting has been found to be much more intelligible to the average factory operator than discussing rates.

In approaching a mill operator upon the motor question, it has been found a good policy, at the first interview, to ascertain as closely as possible what effect the introduction of central-station service will have upon the constant charges of his present plant: It is well known that the economy effected by the centralization of a power supply is mainly in the constant charges; therefore, if the conditions in the private plant be such that only a small proportion of the constant charges could be eliminated upon the introduction of electric service, it would not be advisable for the central station to conduct an elaborate test to determine the operating requirements of a condition it

cannot meet. The above condition has been found to exist in some cases, where large quantities of high-pressure steam are needed in a manufacturing process, particularly in textile mill, dye house, or laundry operation, where an engineer must be retained whether energy is generated by an engine or supplied by a central station.

The only hope of the central station's competing under these conditions would be through being able to effect such economies by the proper selection of motors as to be able to cut down the amount of energy to be supplied from the service main far below that delivered by the isolated plant. With a casual look over the prospective customer's machinery equipment, one should be able to determine the possibility of accomplishing anything along this line that would make it advisable to conduct a test and formulate a proposition.

It is not always necessary for a central-station company to meet the existing cost per hp-hour at which a certain private plant is operated. In the first place, in a great majority of manufacturing establishments, the average as well as the maximum power required to drive the machinery can be materially reduced by a well-arranged motor equipment obtaining energy from a central station. Therefore, at even a higher rate the gross cost per annum will probably show a saving over isolated plant operation.

Whatever the conditions may be, the two most vital points of all, and the most important ones to the manufacturer, are the cost per unit and the quality of his finished product, as his selling price and profit are based upon these points, as well as upon his ability to meet successfully keen competition. They should furnish one of the strongest arguments in favor of central station service.

There are a great number of machines in all lines of trade in which the production varies with the speed; also, the more constant the speed the more perfect is the product. Consider, for example, what happens to be the speed of machinery distributed over several floors of a mill driven by a mass of belting operated by an engine, usually located in the basement. There is a certain amount of slippage or loss of speed between the driver and driven pulleys, the slippage, particularly in the main drive transmission, being considerably greater under heavy than light loads, and the size of the pulley on each group of machines must be so proportioned that the maximum speed permissible on the machine will not be exceeded when the lightest load occurs on the main belting transmission. Therefore, during the busiest seasons when the heaviest loads are carried, the speed falls considerably below the permissible maximum, the production of each machine falling off in proportion, at the very time that increased production is desired. By equipping each group of machines with a motor of the proper rating the machines can be maintained at their maximum speeds and production becomes independent of the conditions in the other departments of the mill.

Assume that the production by the above means has been increased by 5 per cent, and the cost of energy has been increased by 5 per cent; the cost of energy and raw material per unit of production, therefore, remains the same, but the gross cost per unit output is lower, because the same labor and other fixed charges are productive of a greater output of finished material.

In the case just cited it has been assumed that the engine was properly proportioned for the work, and the speed regulation at the engine at all loads was considered to be the best that could be obtained. Frequently in a plant the engine is overloaded to such an extent that the operator is compelled either to run all the machinery at greatly reduced speed or to shut down part of the machinery in order to get the work out of the remainder. Under conditions of this kind it would be economical for the owner to expend a considerably greater amount for energy. It is always poor policy to economize on energy at the sacrifice of production.

Quite often one encounters a prospective customer who objects strenuously to a central station asking a minimum charge. Of all the objections, this one appears to be the most unreasonable. Assume that this man requires a 50-hp equipment to operate his machinery, and that he installs a steam plant to do the work. There is a fixed charge on the equipment alone that often represents considerably more than the minimum charge asked by the central station company. If the prospective customer is a fairminded man, he should be able to appreciate the justice in the charge of the central station company. In addition, it would be well to call his attention to the fact that the central stations have certain costs that are proportionate to the station and line equipment necessary to supply energy, which represent a certain cost per year per unit of capacity, entirely independent of the amount of energy supplied. It is, therefore, no more than fair that this fixed charge be distributed equally, each customer bearing his share in proportion to whatever relation his equipment bears to the entire connected load of the central station.

In some cases the prospective customer advances the argument that he can put in a gas engine and pay the gas company for only the amount of gas that he uses, and if he does not use gas for a month at a time, he pays nothing, and asks why the gas company can do business without asking a minimum guarantee while we cannot. The answer to this is very simple. In the manufacture and supply of gas they deal with averages; therefore, it is not a question of providing station generating capacity equal to the demand at any particular time, the gas being generated continuously at a rate many times less than the maximum demand, and operated 24 hours per day, the product being stored in receiving tanks; therefore the consumers' demand is spread over the entire day's operation, and only affects the generating capacity in proportion to the average over this period.

It is therefore apparent that the consumers' demand is not so serious a consideration with the gas company, while in the manufacture and distribution of electric current it is necessary to provide sufficient station capacity to take care of the maximum demand, even if this demand exists for only 10 minutes with a comparatively small output in kw-hours.

The gas engine is theoretically an economical apparatus, but on account of its many intricate parts, in a great many cases, it is an untrustworthy source of energy. Another serious objection is the heavy friction loss in the engine itself, which means that the efficiency falls off very rapidly at low loads; this is quite a serious factor in the majority of cases, because, on account of the inability of a gas engine to carry a load above its rated output even for a short time, it is necessary to install an engine of sufficient size to take care of the maximum demand even if the load occurs for only five minutes during the day, while the remainder of the time it may be operating at 20 per cent of its output or lower.

In a case of the above kind a motor of one-half the rating would be ample to drive the machinery, and would therefore be operating at a 40-per-cent load factor at more than double the efficiency. Therefore, no direct comparison can be made in rates per hp-hour.

The manufacturers of a great many gas engines claim that their engines will consume only 17 cu. ft. of city gas per hp-hour, but they often fail to mention that this value is reached only at full load. As a matter of fact, the consumption per brake hp-hour delivered at the pulley may be anywhere from 17 cu. ft. to 70 cu. ft., depending entirely upon the average power delivered.

It may well be conceded that under ordinary conditions, if fuel alone were considered, the gas engine would afford a source of cheap energy, but, viewing the proposition from the standpoint of a factory operator, whose production is dependent entirely upon the source of energy supply, the fuel economy becomes a very insignificant figure as compared with the delays and other expenses with which he must contend. Therefore, one should impress upon the prospective customer that economy in production means more to him than economy in fuel; in other words, let the war cry be "quality," not "price."

INTERIOR WIRING AND ILLUMINATION

Voltage and Current Values in Three-Phase Circuits.

By Emil G. Bern.

The ordinary process of finding the current capacity of a three-phase machine or circuit for given kilowatts and voltage is, by means of the indispensable slide rule, to multiply the voltage by 1.73 and divide the kilowatts by this product. This method is, of course, accurate enough for most practical purposes if carefully performed and the decimal point not misplaced, and simple enough if not occurring too often.

The accompanying table will serve as a quick reference for the most common voltages and kilowatt capacities; others may easily be interpolated, and for this purpose the table has been carried to three decimal places. In addition to this, the first column of the table gives the three-phase star voltage of the third column, read as phase voltage; and the second column gives the phase voltage for the third column, read as star voltage.

VOLTAGE AND CURRENT VALUES IN THREE-PHASE CIRCUITS.

Volts × √3.	Volts / √3.	Volts.	100 per cent power factor. Kilowatts. 50.	100.	200.	300.	400.	500.	600.	700.	800.	900.	1,000.
190.525	63.508	110	262.431	524.863	1,049.727	1,574.591	2,099.455	2,624.319	3,149.183	3,674.047	4,198.911	4,723.774	5,248.638
381.051	127.017	220	131.215	262.431	524.863	787.295	1,049.727	1,312.159	1,575.591	1,837.023	2,099.455	2,361.887	2,624.319
571.576	190.525	330	87.477	174.954	349.909	524.863	699.818	874.773	1,049.727	1,224.682	1,399.637	1,574.591	1,749.546
762.102	254.034	440	65.607	131.215	262.431	393.647	524.863	656.079	787.295	918.511	1,049.727	1,180.943	1,312.159
1,039.230	346.410	600	48.112	96.225	192.450	288.675	384.900	481.125	577.350	673.575	769.800	866.025	962.250
1,991.858	663.952	1,150	25.102	50.204	100.408	150.613	200.817	251.021	301.226	351.430	401.634	451.839	502.043
3,983.716	1,327.905	2,300	12.551	25.102	50.204	75.306	100.408	125.510	150.613	175.715	200.817	225.919	251.021
5,715.767	1,905.255	3,300	8.747	17.495	34.990	52.486	69.981	87.477	104.972	122.468	139.963	157.459	174.954
7,621.023	2,540.341	4,400	6.560	13.121	26.243	39.364	52.486	65.607	78.729	91.851	104.972	118.094	131.215
11,431.535	3,810.511	6,600	4.373	8.747	17.495	26.243	34.990	43.738	52.486	61.234	69.981	78.729	87.447
19,052.558	6,350.852	11,000	2.624	5.248	10.497	15.745	20.994	26.243	31.491	36.740	41.989	47.237	52.486
22,863.070	7,621.023	13,200	2.186	4.373	8.747	13.121	17.495	21.869	26.243	30.617	34.990	39.364	43.738
38,105.117	12,701.704	22,000	1.312	2.624	5.248	7.872	10.497	13.121	15.745	18.370	20.994	23.618	26.243
51,961.524	17,320.508	30,000	.962	1.924	3.849	5.773	7.698	9.622	11.547	13.471	15.396	17.320	19.245
57,157.676	19,052.558	33,000	.874	1.749	3.499	5.248	6.998	8.747	10.497	12.246	13.996	15.745	17.495
77,942.286	25,980.762	45,000	.641	1.283	2.566	3.849	5.132	6.415	7.698	8.981	10.264	11.547	12.830
103,923.048	34,641.016	60,000	.481	.962	1.924	2.886	3.849	4.811	5.773	6.735	7.698	8.660	9.622
173,205.080	57,735.021	100,000	.288	.577	1.154	1.732	2.309	2.886	3.464	4.041	4.618	5.196	5.773

Interconnections of Transformers in Four-Wire Three-Phase Systems.

By K. Faye-Hansen.

As is well known, it is in many cases desirable to operate three-phase motors at a higher voltage than is suitable for lamps. For this purpose a fourth or neutral wire may be installed, the lamps being connected between the outer wires and the neutral, and the motors being across the outer wires. The lamps will thus have a voltage equal to 58 per cent of the motor voltage. This method of distribution permits of a very large saving in copper for feeders and cables over that with the ordinary three-phase, three-wire systems, where the motor voltage is limited by the lamp voltage. The four-wire system is, however, not used in all cases where is could be advantageously adopted, probably because the different means of obtaining balanced voltages between the different phases and the neutral when the lighting load is unbalanced are not widely enough known. In order to operate a four-wire, three-phase system it is necessary either to extend the neutral wire back to the generator or to the main transformers, or to use special three-phase, four-wire "balancers."

When the neutral wire can be extended to the generator, no difficulties are encountered so long as the percentage of the out-of-balance current is not excessive, but the cost of the neutral wire will often prove to be prohibitive. When the neutral is extended to the main transformers, the latter may be connected in "star" both on the primary and on the secondary side. If the transformers consist of a group of three single-phase transformers or are of the three-phase shell type, in all cases it will be necessary to connect the neutral point of the transformer with the neutral of the generator, because otherwise the ampere-turns on the different phases may be unbalanced and cause a very considerable voltage distortion.

Fig. 1 shows the winding and the vector diagram for a transformer in "star-to-star" connection, the arrow heads indicating the direction of the current at a given moment when only one phase winding is loaded—the load being between terminal *c* and the neutral wire.

If the main transformer is of the three-phase core type in "star-to-star" connection and the current in the neutral can be kept very low compared with the normal current of the transformer, the arrangement may work quite satisfactorily, because the interlinking of the fluxes in the three cores will have some balancing effect. If the unbalanced load is large, however, it will be necessary to connect the neutral point of the transformer primary winding to the neutral point of the generator.

Owing to the cost, etc., it is usually preferred not to use an extra fourth lead between the transformers and the generator, the transformer being normally connected in "delta" on the high-tension side and in "star" on the low-tension side. By means of this connection, which was first proposed by Mr. Dobrowolsky, balanced voltages between the neutral and the outer wires can be obtained at large unbalanced loads. This connection is shown in Fig. 2, where the direction of currents is again indicated by arrow heads. From Fig. 2 it will easily be seen that the ampere-turns on each core leg should balance even when only one phase winding is loaded.

For high primary voltages, and especially for small outputs, the "delta" connection on the high-tension side will involve a considerably more expensive and less efficient transformer than if "star" connection can be used, because there are required 73 per cent more turns, each being of a smaller size wire and consequently requiring more space for insulation. Instead of the "delta-to-star" connection, the connection of the primary side in "star" and of the secondary side in "interconnected star," as shown in Fig. 3, can also be used for three-phase, four-wire systems. This connection, which was first proposed by Mr. J. S. Peck, is usually preferable for high voltages and small outputs to the "delta-to-star" connection, as the high-tension winding will be exactly the same as for the "star-to-star" connection. On the low-tension side, however, 15 per cent more turns and 15 per cent more copper will be required than for the "star-to-star" connection.

Instead of the above connections, the "star-to-star" connected transformer may be provided with one auxiliary coil per core leg, these coils being connected in "delta" as shown in Fig. 4. This connection, as well as similar connections—as, for instance, Fig. 5, which shows a "star-to-delta" connection with an auxiliary winding on the low-tension side for reaching the neutral point—is to the writer's knowledge very seldom or never used in practice, though under special circumstances it might prove to be advantageous. The necessary current-carrying capacity of the auxiliary windings in these cases is determined by the out-of-balance load expected.

It might be noted that all transformers in "delta-to-star"

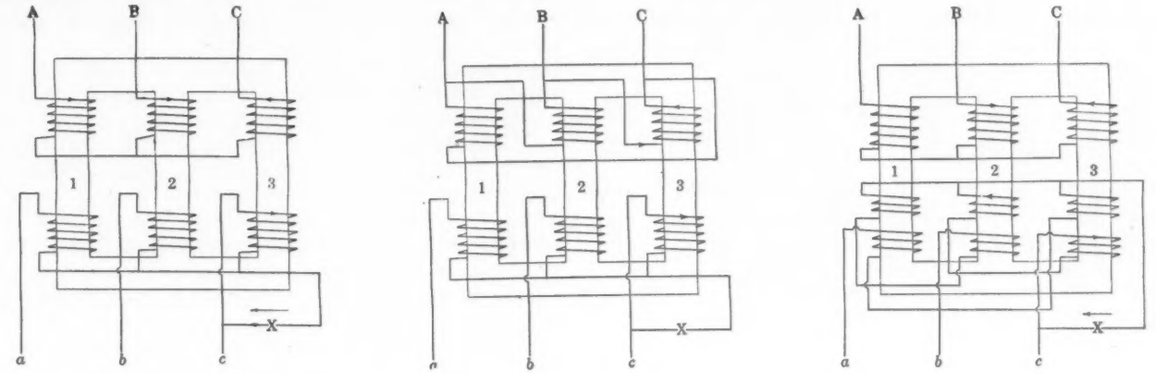
connection, and in "star" to interconnected star, as well as transformers in "star-to-delta" connection can be made to work in parallel with each other, but they cannot work in parallel with transformers in "star-to-star" connection or in "delta-to-delta" connection.

Three-phase, four-wire "balancing" coils can in many cases be used to advantage. The "balancing" coils can be placed at

(b) The voltage displacement in the neutral wire is reduced, so that better balancing voltage between the different leads is obtained.

(c) The current is more equally distributed between the line wires.

(d) A standard polyphase wattmeter can be used instead of a special four-wire wattmeter.



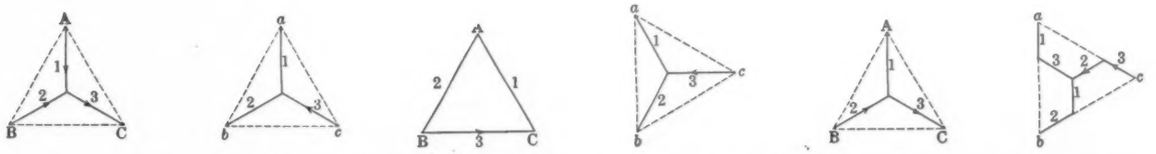


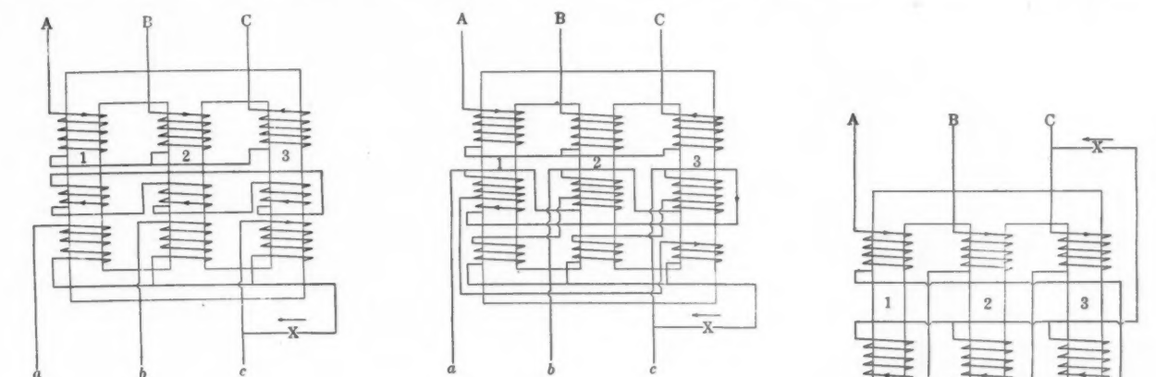
FIG. 1.—TRANSFORMER COILS IN "STAR-TO-STAR" INTERCONNECTION. FIG. 2.—TRANSFORMER COILS IN "DELTA-TO-STAR" INTERCONNECTION. FIG. 3.—TRANSFORMER WITH PRIMARY COILS IN "STAR" AND SECONDARY COILS IN "INTERCONNECTED STAR."

those points where the lighting is required, and thus a saving in the length of the neutral wire can be obtained. The best form of balancing coil consists of a three-phase auto-transformer with a lead joined to the neutral point. The three-phase windings are so interconnected that when electricity flows into the neutral it passes equally through the three-phase windings of the balancing coil, so that no unbalanced ampere-turns will be produced in any of the phase windings, as shown in Fig. 6. The advantages obtained by using balancers are as follows:

(a) The length of the neutral wire may be greatly reduced.

(e) It is possible to supply energy to a four-wire circuit from a transformer group connected in "star-to-star" or in "star-to-delta," thereby saving in cost of the main transformers.

The advantages by using "balancing" coils will be specially large when the amount of power required for the lighting is small compared with the power required for the motors.



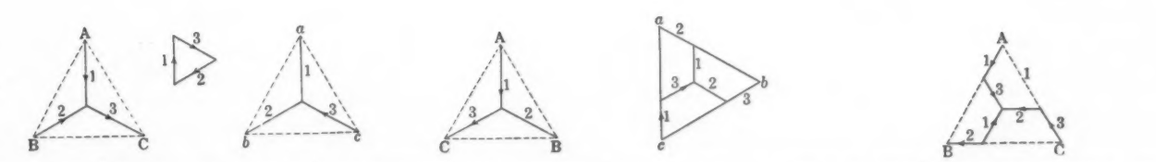


FIG. 4.—TRANSFORMERS USING "DELTA-INTERCONNECTED" AUXILIARY COILS. FIG. 5.—"STAR-TO-DELTA" INTERCONNECTION WITH AUXILIARY COILS FOR REACHING THE NEUTRAL POINT. FIG. 6.—THREE-PHASE AUTO-TRANSFORMER BALANCER.

For existing circuits where "delta-to-star" transformer interconnection is now used, it will, therefore, often be advantageous for future extensions to use "star-to-delta" transformers (which can be operated in parallel with "delta-to-star" transformers) as these will have the same price and efficiency as "star-to-star"

transformers, and to obtain the four-wire circuit by means of the "balancers" described above.

Regarding the size of the balancing coils it is to be noted that for a 100-kw circuit, where the maximum out-of-balance current would be 25 per cent of the full-load current in the outer wires, a three-phase transformer of a size corresponding to a standard 5-kv-amp transformer would be required, and the out-of-balance of the phase voltage at this value of neutral current would correspond to one-third of the percentage drop of a standard 5-kv-amp three-phase transformer.

New Telephone Patents.

TELEPHONE INSTRUMENTS.

With the usual head receiver there is a circular permanent magnet contained within a thin walled insulating case. This magnet comprises a considerable portion of the weight of the receiver. In an effort to lighten the weight, Mr. J. S. Goldberg, of Chicago, has combined the casing and the magnet. In order to do so, a ring of steel with an internal flange at one edge forms the body wall. This is magnetized with consequent poles, the pole pieces being secured to the flange by screws. The diaphragm is non-magnetic and is provided with an armature slip at its middle. The patent for this receiver has also been assigned to the Stromberg-Carlson Company.

In Fig. 1 is shown, in section, a transmitter patented by Mr. F. G. Warrell, of Lansdowne, Pa., and assigned to the Euelectric Company. The metal box carries an insulating lining, and an annulus of insulation is dropped in against its bottom shoulder. The aperture of the annulus carries the rear electrode. The box is closed by a diaphragm, after being filled with granular carbon. The diaphragm carries at its middle the movable electrode, the exposed inner face of the diaphragm and the cylindrical surface of the electrode being covered with an insulating coating.

Another type of transmitter forms the subject of a patent issued to Mr. M. S. Conner, of Rochester, N. Y., assigned to the Stromberg-Carlson Company. In this type of instrument both electrodes are carried by the diaphragm, a mass of granular carbon being held against them by a box-like casing, closed by an auxiliary mica diaphragm. The two electrodes are placed

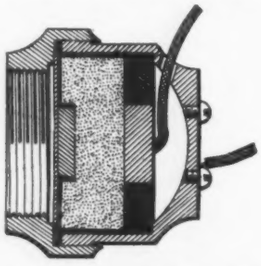


FIG. 1.—WARRELL TELEPHONE TRANSMITTER.

to form a disk with an open band along one diameter. In mounting the electrodes a sheet of insulating material is bent and cut so that when the electrodes are placed upon it, a fold of the insulator just fills the open slot. The microphone button is assembled and mounted approximately as is the front electrode of the well-known "solid-back" instrument, except, of course, that the electrodes are insulated from their holder. The Stromberg-Carlson Company has obtained this patent by assignment.

IMPROVEMENTS IN SWITCHBOARDS.

There have recently been issued three patents covering the design and arrangement of apparatus used in multiple switchboards, all with a view to improving the general design. One of these covers a new type of jack strip, the springs of the individual jacks being so made and shaped that they alone suffice for connecting the face and rear strips of the jacks. The end strips are, therefore, omitted, with the result that the panel widths of the switchboard may be cut down without decreasing the individual jack spacing. Mr. J. A. Birsfield, of Rochester, is the inventor.

Mr. M. S. Conner has arranged swinging frames for the rear equipment in order to increase the accessibility. The rear equipment usually comprises coils, relays and terminals requiring access from both sides. As usually mounted, both the front and the rear of the switchboard must be opened in hunting trouble. With the frame arrangement, the apparatus may be swung out as a whole, and becomes entirely accessible from the rear.

In most multiple switchboards there is of necessity a division made in the mass of multiple cable, which lies behind the multiple jacks. The division is usually made near the bottom, the subscriber's multiple resting on top of a cable board or shelf, and the trunk multiple hanging beneath the shelf. In order to obtain access to the trunk jacks it is necessary to release the cables at times and allow the lower ones to drop. Various forms of adjustable support have been devised. A

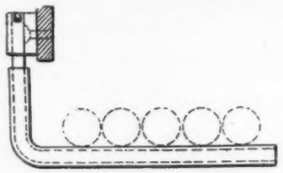


FIG. 2.—HAWKINS CABLE SUPPORT.

very neat swivel form is shown in Fig. 2. This is the invention of Mr. E. A. Hawkins, of Baldwin, N. Y. The operation is almost self-evident. When it is desired to drop the cables, the support is lifted until its lock pin is above the slot in its holder and then the cable support is turned to one side until it parallels the lay of the cables.

All of the above patents have been assigned to the Stromberg-Carlson Company.

SUBSCRIBER'S STATION EQUIPMENT.

In one of the popular types of common-battery substation circuits, the transmitter is in series with a retardation coil, the receiver with a condenser in series being bridged around this coil. Heretofore a special impedance coil has been used, but Mr. H. M. Post, of Chicago, has now patented an arrangement according to which the ringer coils serve as the retardation. The ringer must, of course, be "low wound." Mr. Post has assigned his patent to the Kellogg Switchboard & Supply Company.

Six patents have recently been granted to Mr. H. Tideman, of Menominee, Mich., for substation apparatus. Three describe designs of ringers and three hook switches. The chief idea for the ringers is to simplify construction and to this end either the frame is omitted or the permanent polarizing magnets serve in this capacity. Where the frame is omitted, a non-magnetic yoke, carrying the armature pivots, is secured to the pole ends. In one form the yoke is adjustable upon the cores, to effect adjustment of the ringer.

In the hook switches, use is made of a spiral spring, a removable lever and a self-contained structure. In one arrangement the spiral of the spring is arranged along a groove in the body of the hinge screw.

TELEPHONE REPEATER.

In an endeavor to solve the repeater problem there have been from time to time suggestions tending toward the supply of additional energy at the repeater from a mechanical source. Naturally, these have all taken the suggested form of a repeating generator, in which the armature circuit becomes a retransmitting circuit and the field circuit, either directly or indirectly, the receiving circuit. At first sight it would seem that the repeating machine must of necessity be of the direct-current type, which apparent requirement would completely defeat the end sought because of the irregularities introduced by the commutation. Mr. E. F. W. Alexanderson, of Schenectady, has now, however, patented a generator repeater, using an alternator of the indicator type. According to the proposed scheme, the

alternator is made to deliver normal currents of a frequency far above the range of the human ear. Because of this, their presence upon the line involves no disturbance. By varying the field of such a generator the instantaneous amplitudes of the normal wave is varied, and if the varying current impressed on the field be that of a telephone circuit, then the resultant effect of the delayed amplitude of the output current of the machine will be an exact counterpart of the received wave. Of course, this is all upon the theory that the operation is distortionless. Mr. Alexanderson has made his field armature stationary and revolves in the field a multi-pole indicator of high speed, the indicator being given a section for maximum strength against centrifugal stresses because of the high velocity required for the necessary normal frequency. The General Electric Company has obtained Mr. Alexanderson's patent by assignment.

Mr. L. A. Lindsey, of Crystal Springs, Ga., has also obtained a patent for a repeater. This is of the tele-microphone type and is particularly designed with a view to producing a maximum motion of the receiving parts, while at the same time providing for an equal motion of the transmitting parts. An annular field is formed for the receiving part. This is obtained from a round-core electromagnet with a return pole-piece surrounding the coil. The end of the return pole-piece is formed into a cylinder surrounding the end of the core, so that a narrow annular air-gap is left about the core end. The transmitting part is placed immediately before the poles of the electromagnet, the movable electrode being secured directly to the inside of the diaphragm. Opposite this there extends a tubular non-magnetic extension, which surrounds the electromagent core and projects almost the full depth of the air-gap. Upon the end of this tube, or spool, is wound a receiver coil, all of which is, therefore, contained within the annular air-gap. The receiving circuit is led through the receiver coil, while the microphone button is connected directly in the primary of the sending circuit.

INSTRUMENTS AND ATTACHMENTS.

A pocket antiseptic device for transmitter mouthpieces is the subject of a patent issued to Mr. J. Baumgarten, of New York City. This consists of a cloth-covered spring, mounted within a metal casing. The form of the spring approaches that of the inside of a transmitter mouthpiece, while the size of the casing is such that, with the lead open, the casing will just slide over the lips of the ordinary mouthpiece. The arrangement suggests at once the familiar one of the "Jack-in-a-box." Normally the spring is compressed within the casing beneath the lead, the whole being the size of a watch. When the cover is released it flies open and the spring extends, forming a lining for the mouthpiece.

Mr. G. Kracker, of Philadelphia, has obtained a patent for what he terms a "transmitter muffler." This comprises a somewhat bulky metal attachment, adapted to surround and seal off the mouthpiece of the transmitter. The attachment is in three sections and divided by transverse walls, perforated concentrically to form a direct passage to the transmitter mouthpiece. The rear compartment is the clamping compartment, the lips of the mouthpiece being held tightly against the rear transverse wall. The middle section is the "muffler" section. This affords a long passage from the central aperture to the outer air. This passage takes the form of a long spiral about the central aperture, very much in the form of the old-style automobile muffler. The front section of the attachment is equipped with rubber cushion edges to meet the contour of the face of the user to completely seal off the mouth from the outside air.

A receiver-holding attachment has been patented by Mr. G. J. Thomas, of New York City. This is adapted to be clamped upon the vertical stem of a desk-stand set, and by means of stiff links terminating in a clamp, the usual hand receiver will be held in such a position as to confront the ear of a user of the instrument. When not in use the receiver supporting link is rotated about a horizontal axis, the weight of the receiver tending to continue this motion. In this position the receiver stands vertically in front of the transmitter and a dog, carried by a rotating link, bears down upon a slide bar in a manner to depress the receiver hook.

LETTERS TO THE EDITORS.

Artificial Daylight Aurora and the Cause of Uncertainty of Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—The Marconi Company has a station in South Wellfleet, Barnstable County, Mass., on a high sand bank forming part of the shore of the Atlantic Ocean. I have made journeys to that locality to try to observe optical phenomena during the working of the station and the following are some of those which have been seen:

First: Bands of color, varying from white to pink, visible by daylight in the south, extending from the ocean horizon line to a height as great as 40 or more degrees. Second: White bands where the ocean and sky appeared to join, extending through the 180 deg. of ocean horizon visible, varying in duration and intensity; never extending more than a few degrees above the horizon. Third: The formation of light fogs obscuring vessels which were before very distinct.

The third observation is interesting, as it shows how the ether motions produced by the sending station are used up in electrifying the air, causing a condensation of invisible particles of water vapor into larger drops forming a fog, and giving optical evidence why wireless telegraphy will for some time remain an uncertain method of communication.

BOSTON, MASS. WILLIAM ROLLINS.

Economy, Efficiency and Efficacy in Illuminating Engineering.

To the Editors of Electrical World:

SIRS:—I read with much interest the remarks of Mr. A. J. Marshall in the Nov. 14 issue of your paper, regarding "The Economy, Efficiency and Efficacy of Illuminating Engineering" and I heartily indorse and second his plea for breadth of view in attacking problems of illuminating engineering. I fully agree that it would mean "false" economy and, indeed, be "undesirable" to sacrifice "efficacy" for "economy," and it is just the ability of balancing one against the other that is the foundation of proper engineering. I also agree in the protest against violation of esthetics in the application of illuminating engineering, but I believe there is not much danger in this direction if correct illuminating engineering principles are applied. Practical experience has taught that real improvements in illumination accord also with esthetic appearance. That this is not an accident, but a logical consequence of proper illumination, will be evident to everyone who has made a thorough study of the origin, development, history and philosophy of esthetics and of art.

Mr. Marshall's pessimism seems, therefore, to be rather ill-founded and there is no reason to be afraid that the goddess "Beauty" will ever be dethroned by her rival, "Efficiency." It rather seems to be the duty of everyone who advises the youthful illuminating engineer as to his best course, to insist that he shall ground himself thoroughly in the essentials of his art instead of wasting his energy on the art of the Renaissance and Louis XIV. With a thorough knowledge of fundamentals, the illuminating engineer will doubtless be in the position to take care of himself and thus to be a useful and, therefore, desirable citizen of the community.

NEW YORK. ALFRED A. WOHLAUER.

Governmental Regulation of Central Stations in Germany.

To the Editors of Electrical World:

SIRS:—Your editorial comment of Nov. 7, on "Police Regulation of Central Stations in Germany," creates a wrong impression on the reader, as did your editorial of June 6 on the

same subject, to which your attention has been called in a letter published July 4. Your statement "There is nothing incongruous to the German mind" may be right in many respects, but the idea of "a police officer walking into a central station and examining a coal pile and ash circulation, boilers, engines, switchboard, and making copious notes," is, as you rightly quote, "for the American mind, humorous and burlesque"; it is still more so, and in fact a huge joke to one familiar with German governmental regulations.

The original fault of both editorials is due to the reviewer of the *Elektrotechnische Zeitschrift,* of which you have extracts in the above two issues. The German word "Polizei" includes all kinds of governmental regulations and supervision for the safety and welfare of the general public, such as building and boiler inspection, etc.; the "police," for maintaining public order and restraining open lawlessness, is but one department of the above.

Central-station inspectors, as well as all inspectors for engineering work, from the German point of view, are supposed to be engineers of the highest education, and are usually holders of a diploma from one of the technical high schools. Our American idea of police is represented in Germany by the words *Schutzmann* and *Gendarme;* the latter are mounted. Their principal training is from having served two to six years respectively in the army with satisfactory results. With these explanations it is readily seen that there are things "incongruous to the German mind," for instance, in your two editorials.

New York. Frank Koester.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Iron Losses in Induction Motors.—O. S. Bragstad and A. Fraenckel.—The first part of an account of an investigation of the so-called "additional iron losses" in induction motors. These "additional losses" have formerly been found to be almost as large as the iron losses due to the rotary field, and to constitute a considerable part of the whole no-load loss. The "additional losses" may be divided into two classes. First, the pulsation of the induction in the air-gap at the place of the slits of the stator and rotor slots produces eddy currents in the heads of the teeth of the rotor or stator opposite to the slits. These are called surface losses. Second, the total flux in a tooth changes with the position of the opposite teeth and slots so that a pulsation of the induction in the whole tooth is produced. The frequency of these pulsations is proportional to the number of slots passing per second along a tooth. These losses are called tooth pulsation losses. Both kinds of losses are investigated separately, and formulas are given for calculating the losses. The paper is to be concluded.—*Elek. Zeit.,* Nov. 5.

Turbo-Alternators.—A note on a recent British patent (19,882) of the British Thomson-Houston Company and F. H. Clough on rotor-field construction for turbo-alternators. The holes for the exciting winding are tunneled at a greater depth below the surface of the rotor than usual, and the iron above the holes is cut away between the poles to lessen the magnetic leakage. By this means the use of teeth of non-magnetic material between the poles is rendered unnecessary. The end connections are surrounded by a retaining ring, the diameter of which does not exceed the internal diameter of the stator. The arms of the spider are arranged to come opposite to the pole centers.—Lond. *Elec. Eng'ing,* Nov. 5.

Transformers.—An illustrated description of the Berry transformer, made by a British company, from its early days to the present time. Notes are given on the mechanical make-up of this type of transformer.—Lond. *Electrician,* Nov. 6.

Lamps and Lighting.

Electrodes for Search-Lanterns.—A note on a recent British patent (12,556) of the Siemens Bros. Dynamo Works. The reduction of the section of the negative electrode in search-lanterns is known to increase both the intensity and the steadiness of the light. According to this invention the electrode is protected from being too quickly consumed by providing it with a cover of copper or other metal. The copper sheath is melted off before the arc is reached, and there is no discoloration of the arc. By this arrangement a negative electrode for 150 amp need have a section of only 0.8 sq. cm instead of 5.0 sq. cm. The positive electrode is arranged horizontally, and the negative is inclined at an angle of about 60 deg. to the horizontal.—Lond. *Elec. Eng'ing,* Nov. 5.

Supports for Metal-Filaments.—A note on a British patent (6245) of the British Westinghouse Metal-Filament Company. Owing to the high coefficient of expansion of metal-filaments, it is necessary to have a flexible support at the end of the loops. Instead of using a spring, it is proposed to hang a short wire loosely on to the filament, and to limit the movement of this wire by passing it through a short glass tube or a wire loop, the other end of the wire being bent to prevent it slipping through the tube or loop.—Lond. *Elec. Eng'ing,* Nov. 5.

Holophane Reflectors for Metallic-Filament Lamps.—Fig. 1 shows the distribution of light from a 110-volt, 25-cp metallic-filament lamp of German make, with and without a special

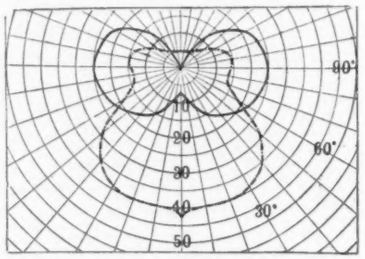


FIG. 1.—CURVES OF LIGHT DISTRIBUTION.

holophane reflector. The drawn outline refers to the lamp without reflector, the dotted line to the lamp with reflector.—*Elek. Zeit.,* Oct. 29.

Generation, Transmission and Distribution.

Plant Efficiencies.—H. M. Hobart.—A note on the limitations to the over-all efficiencies attainable in the generation of electricity from fuel by means of steam. Assuming that all of the energy in the fuel may be transferred to the contents of the boiler, instead of only the 70 per cent to 80 per cent obtainable in practice, and assuming that there are no losses in the steam-electric generating set, then the obtainable over-all efficiency is a function of the temperature of the feed water, the temperature of the steam at admission to the steam-electric generating set, the pressure of the steam at admission to the steam-electric generating set and the pressure maintained by the condenser. Within the reasonable range of values the temperature of the feed-water exerts so slight an influence that the feed-water temperature may be taken as 50 deg. C. On this assumption and on a further assumption of 100 per cent efficiency of the steam-raising plant and 100 per cent efficiency of the generating sets, the author gives the following table of over-all efficiencies expressed in per cent:

	Saturated steam.			Steam superheated 100° C.		
Steam pressure at admission in kg. per sq. cm.....	6.	9.	12.	6.	9.	12.
Condenser pressure in kg. per sq. cm.						
0.1.....	24.0	26.0	27.8	25.0	27.1	28.4
0.2.....	20.5	22.7	24.6	21.5	23.7	25.5
0.4.....	17.3	19.3	21.0	18.1	20.3	21.7

With data of the actual efficiencies obtaining with the steam-raising plant and the generating sets employed, the over-all efficiencies for any given case may be deduced at once. Thus, if with feed water at a temperature of 50 deg. C. and with 100 deg. C. of superheat, an admission pressure of 9 kg. per square centimeter and an exhaust pressure of 0.10 kg. per square centimeter, the boiler efficiency during the average conditions of service throughout the year is 65 per cent, and the corresponding efficiency of the steam-electric generating set is 60 per cent, then the over-all efficiency from the coal to the switchboard is $27.1 \times 0.65 \times 0.60 = 10.5$ per cent. This is the annual over-all efficiency for such conditions; this value is obtained only in well-managed electricity supply stations of large capacity. There is a great difference between the efficiency obtained on a special test of a single generating set and the average efficiencies over the whole year for the entire plant. It is only in rare instances that 10 per cent has been exceeded, and 8 per cent is still a very creditable figure. The aggregate efficiency of all the electricity supply stations of Great Britain, that is, the percentage which the total energy delivered to the outgoing cables from all these stations bears to the energy in the coal burned in all these stations, would probably be more of the order of 3.5 per cent to 4.0 per cent, and certainly does not yet exceed 4.5 per cent.—Lond. *Elec. Times,* Nov. 5.

Selection of Turbo-Alternators.—M. KLOSS.—A paper read before the Manchester section of the (British) Inst. Elec. Eng. on some practical considerations in the selection of turbo-alternators. The three points dealt with in this paper are: (1) ventilation, (2) voltage regulation, and (3) power factor. As regards (1), the best scheme is shown to be to take fresh air from outside the building and prevent hot air entering the engine room; (2) voltage rise figures for turbo-alternators are shown to be higher than those usual in multipolar machines; (3) it is shown that it is not advantageous to specify a power factor lower than that actually prevailing in the station.—Lond. *Electrician,* Nov. 6.

Electricity in a Mine.—K. PERLEWITZ.—The conclusion of his very long illustrated serial on the electric equipment of the King Ludwig mines in Recklinghausen. The company operates two coal mines at a distance from each other, with by-product coke oven plants. The electrical energy is produced in two high-tension stations of 4200 and 1100 kw-amp respectively. Energy is transmitted to three substations, two of which are underground. The power stations produce three-phase currents at 5000 volts and 50 periods. The voltage is reduced to 230 for motors and to 120 for lamps. The uses of electric motors for coal separation, coal washing, pumping, traction, and for driving compressors, ventilators, and other machines are described. Special care was taken in the construction of the switchboard and switching arrangements.—*Elek. Zeit.,* Oct. 29.

Indian Power Station.—An illustrated article on the electric power plant of Cawnpore. The whole of the necessary energy both for lamps and motors, as well as for traction purposes, is supplied from a common station. The supply system for the two former purposes is by a three-wire network with an e.m.f. of 450 volts across the outers, while the tramway is supplied at a voltage of 500. The whole of the supply is direct current. There are five generating units having a total rating of 855 kw, and two batteries, one containing 230 cells for lighting work and the other 254 cells for traction purposes.—Lond. *Electrician,* Nov. 6.

Refuse Destruction.—E. STIRNIMANN.—An illustrated description of the new system of refuse destructor plants of the Horsfall Destructor Company, the principal features of which are as follows: Treatment of the refuse by workmen is avoided and the cost of treatment is reduced to a minimum. In charging the destructor batteries no dust or smoke is evolved. The charging port is gas-tight. A high temperature and perfect combustion are claimed even with a low calorific value of the refuse. It is claimed to be easy to renew the lining.—*Elek. Zeit.,* Nov. 5.

Water-Power Plant.—A fully illustrated description of the new plant of the Aluminum Corporation in North Wales. The hydro-electric station contains four units each of 1000 kw.—Lond. *Elec. Review,* Nov. 6.

Traction.

London.—An abstract of the annual account of London County Council Tramways, with editorial comment. The financial result is much better than that of last year, due principally to the increased number of lines operated electrically, and to the development of traffic on the existing electric lines. It is shown that a greatly increased traffic and diminished expenses have resulted from conversion from horse to electric traction. Attention is called to the large proportion of workmen's tickets, these amounting to no less than 27,977,412, or 7.15 per cent of the total number issued. None of these fares amounts to more than 2 cents, even for distances of many miles. This matter is considered to be serious. As regards the actual cost of operation, the figure of 14.12 cents per car-mile for 1906-7 has been reduced to 13.58 cents. The cost of generating energy has been reduced from 1.34 cents per kw-hour to 1.14 cents, each of these figures including capital charges. The figures now obtained must be considered very satisfactory, particularly in view of the high price of coal during the period in question; but the consumption of energy, namely, 2.24 kw-hours per car-mile, seems rather high, showing a considerable increase over the figure for the previous year; namely, 2.02 kw-hours per car-mile.—Lond. *Electrician,* Nov. 6.

Railway Signals.—A. GARDINER.—An illustrated paper read before the Leeds section of the (British) Inst. Elec. Eng. The author first refers to the defects of the present semaphore signaling system, then outlines the main essentials of a perfect system of train control, and finally describes his system of train working with engine cab signals. Parallel to the running rails is laid a metallic "track conductor" (*M* in Fig. 1). The track is split up into track-circuit sections of the desired length

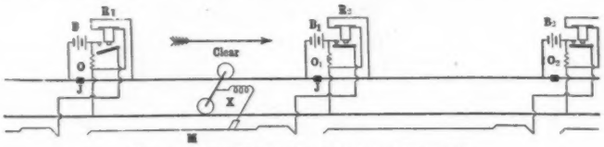


FIG. 2.—DIAGRAM OF SIGNAL CIRCUITS.

(insulated joints *J, J*), and the rails within the limits of these sections are bonded together on each side by one of the usual track-circuit wire bonds. At one end of each section is a track relay (R_1, R_2), and at the other a track battery (B, B_1) or other source of energy for the track relay. Both the relay and the source of energy are connected to the rails in such a way that when no train is on the section the relay is excited and its armature drawn up; when a train enters the section the relay is short-circuited by its wheels and axles and the armature falls away. The armature of the relay carries certain contacts which are closed when the armature is attracted, and for the purpose of this signal it carries also other contacts which will be closed when the armature falls away. A resistance (O_1, O_2) is inserted between the track battery and the track to prevent the battery itself being short-circuited by the trains; and a parallel circuit is then taken from the positive terminal of the battery through the contacts of the near track relay to the track conductor, as shown in the diagram. The track conductor in each section is thus, when the relay controlled by the section ahead is energized, charged with the potential of the track battery above the negative track rail; but it is "dead" when that relay is shunted. Consequently when any track-circuit section is occupied, the track conductor of the track-circuit section in the rear is dead. As far as the first and principal indication to be given on the engine is concerned therefore, namely, "clear" and "stop," all that is required is some means of collecting current from the track conductor, and an electromagnet that will when energized show a "clear" signal, and when de-energized show a "stop" signal by the action of gravity. The action will then be as follows: *X* is a train on a section. If the section (B_2R_2) ahead of a train is clear, its relay R_2 will be energized. The battery B_1 will have part of its current shunted through the

fixed resistor (O_1) and the wheels and axles of the train (X), while part of the current will pass by way of the coils of the signal magnet to the negative rail. The train will thus receive the "clear" signal. If, on the other hand, the section ahead should be occupied (as is the section B_1R_1) the relay (R_1) being de-energized the track conductor will be dead, and a following train will receive the "stop" signal.—Lond. *Electrician,* Nov. 6; Lond. *Elec. Eng'ing,* Nov. 5.

Electric Railways.—F. E. Wynne.—A continuation of his long serial on electric railway engineering. In the present instalment the author shows how to determine the equipment required for each substation and how to choose the units to be installed, together with the necessary auxiliary apparatus. He then takes up the design of the transmission line, which should be constructed with a view to its ultimate load. Curves are given for determining the voltage and the size of the wire to be used. Finally, the determination of generating station equipment is discussed.—*Elec. Jour.,* November.

Rail Brake.—An illustrated note on the Maley brake made by a British company. It is in principle simply a mechanical track brake equipped with a suitable gear so that it is also worked electrically, thus operating as an electromagnetic track brake. This combination ensures that the weight left on the wheels is not lessened by the application of the brake, and skidding is eliminated, because braking in the ordinary sense is not supplied by the wheels, electricity being required merely for energizing the magnets.—Lond. *Electrician,* Nov. 6.

Electric Ignition on Automobiles.—F. R. Babcock.—A paper on the electric equipment of the steam and gasoline automobile. The author first discusses the two methods of ignition, namely, the high-tension or jump-spark and the low-tension or make-and-break spark, and then discusses the sources of current; namely, batteries and generators.—*Jour. Western Society of Engineers,* October.

Wires, Wiring and Conduits.

Austrian Electricity Works.—Statistical tables of the new Austrian electricity works erected in 1906 and 1907. Statistical data on equipment, connections, etc., are given concerning 74 new works and 19 extensions of old works. The number of new stations erected in the last two years was 86, so that the total number of electricity works in Austria is now 532. Among the 74 new works, about which data are given, there are 53 hydro-electric stations, but only 44 use water power exclusively. Only eight stations are operated with steam alone. In 13 stations internal combustion engines, especially Diesel engines, are used throughout. Forty-one of the new stations generate direct current and 33 three-phase current. The latter are almost exclusively water-power stations distributing energy over larger districts. The e.m.f. of distribution is 220 volts in 45 plants and from 110 to 120 volts in 16 stations only. Eight stations distribute energy at 150 volts. The highest transmission voltage is 25,000.—*Elek. u. Mash.* (Vienna), Oct. 25.

Battery Switch.—An illustrated description of a motor-operated automatic battery-switch, shown at the recent Manchester Exhibition. It is a 22-way battery-regulating switch, with a lever arm for regulating on the charging side, and an automatically-operated lever for the discharge side. The latter lever is also provided with a hand-wheel for hand regulation if required. The operating gear, a diagrammatic sketch of which is given in Fig. 3, consists of a frame to which is imparted an oscillatory or rocking motion by a small motor driving a crank through worm gearing. The rocking frame carries a pawl or detent, which engages with a toothed wheel fixed to the discharge lever shaft. The action of this detent is governed by a solenoid K, and the circuit is completed in this coil by spring contacts U and W alternately. In addition to these, limit contacts G and F are fitted to automatically break the motor circuit when the discharge regulator arm reaches either the maximum or the minimum limit. These are protective devices only, and have no other function in the apparatus. The device works as follows: In the event of the pressure falling in the supply circuit in which the magnetizing coil of the contact voltmeter A is connected, contact is made on the lower or minimum terminal of the voltmeter. There is then a circuit from fuse B to the center terminal of the voltmeter, through the minimum contact, through the limit contact F, throught the relay coil D and the fuse C to the main supply. As the contact relay is energized, the motor circuit is completed through relay S, which is controlled by the electromagnet H. The solenoid controlling the pawl or detent is energized through contacts U and W, the movement of the rocking frame alternately closing and opening the circuits through these contacts, alternately engaging and disengaging the detent with the toothed wheel on the discharge lever, and transmitting the motion of the rocking frame to the latter. By this action sufficient cells are brought into circuit to bring the pressure to its normal value. The same operation is carried out in the event of the pressure rising above normal, owing to the load on the battery being reduced, or the battery pressure increasing during charging. In this case the voltmeter makes contact on the maximum or upper terminal. The circuit will then be from fuse B to the center contact of the voltmeter, thence to the maximum contact through the limit contact G, through relay coil E, through fuse C to the main supply. The motor circuit is completed in exactly the same direction as in the first case, the motor rotating in the same direction, but the movement of the discharge lever is reversed owing to the pawl or detent engaging with the toothed wheel on the reverse stroke of the rocking frame. At the normal pressure,

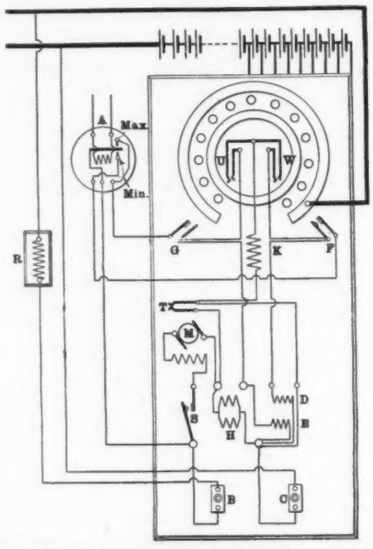


FIG. 3.—DIAGRAM OF BATTERY-REGULATOR CIRCUITS.

the circuit through the motor remains open by the action of the spring contact T, which shunts the coils of the relay magnet H, thereby breaking relay contact S. The contact voltmeter may be regulated to operate within 3 per cent of the normal pressure by adjusting a sliding weight upon the horizontal arm of the lever, and increasing or decreasing the distance between the maximum and the minimum contact disks.—Lond. *Elec. Eng'ing,* Nov. 5.

Electrochemistry and Batteries.

Matter and Energy.—G. N. Lewis.—A highly theoretical paper in which the author presents a revision of the fundamental law of matter and energy. It is postulated that the energy and momentum of a beam of radiation are due to a mass moving with the velocity of light. From this postulate alone it is shown that the mass of a body depends upon its energy content. It is therefore necessary to replace that axiom of Newtonian mechanics, according to which the mass of a body is independent of its velocity, by one which makes the mass increase with the kinetic energy. Retaining all of the other axioms of Newtonian mechanics and assuming the conservation laws of mass, energy, and momentum, a new system of mechanics is constructed. In this system momentum is mv, kinetic energy varies between $\frac{1}{2}mv^2$ at low velocity and mv^2 at the velocity of light, while the mass of a body is a function of the velocity and becomes in-

finite at the velocity of light. The equation obtained agrees with the experiments of Kaufmann on the relation between the mass of an electron and its velocity. It is, however, strikingly similar to the equations that have been obtained for electromagnetic mass. The new view leads to an unusual conception of the nature of light. It offers theoretically a method of distinguishing between absolute and relative motion.—*Phil. Mag.*, November.

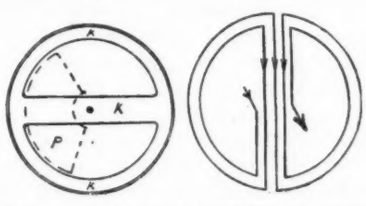
Skin Effect.—F. RUSCH.—A mathematical paper on the skin effect. Lord Kelvin has given the fundamental equations for a straight wire. A. Sommerfeld has developed a theory for a coil wound in the form of a solenoid. The present author develops Sommerfeld's theory in a simpler way and gives the differential equations for calculating the magnetic flux and the current density in a straight wire and in a solenoid. His starting points are the ampere-turn law and the law of induction. Formulas are given for the internal self-inductance and for the resulting resistance. Attention is also drawn to the intimate relation between Kelvin's theory for the skin effect of a straight wire and Sommerfeld's theory for a solenoid.—*Elek. Zeit.*, Nov. 5.

Thermo-Electricity.—J. KUNZ.—A theoretical paper on the corpuscular theory of thermo-electric forces. The author deals in succession with the potential-differences between metals in contact; the thermo-electric force in an unequally heated metallic bar; the e.m.f. of thermo-elements; the Peltier effect; the Thomson effect; the connection between the different effects; the conservation of energy and the resistance of alloys.—*Phil. Mag.*, November.

Transmutation of Elements.—E. RUTHERFORD and T. ROYDS.—Ramsay and Cameron claim to have shown that in the presence of water radium emanation disintegrates into neon. The present authors have carefully repeated their experiments and found that the experiment described by Cameron and Ramsay is quite inadequate as a proof of the production of neon from the emanation.—*Phil. Mag.*, November.

Units, Measurements and Instruments.

Moving-Coil Instrument.—A. SCHORTAU.—An illustrated description of a new type of moving-coil instrument for direct current. Its moving member consists of a thin aluminum disk in which circular and diametral channels are pressed for holding two astatic coils wound as shown in Figs. 4 and 5. This disk moves horizontally in the 1½ mm air-gap formed between the segment-shaped pole-pieces *P* of a permanent magnet. It is only the diametral portion of the coils which is active, as the peripheral portion is wound outside the field. When a current is sent into the coils they tend to move one way or the other according to the direction of the current, and since the field is uniform, the angle turned through will be proportional to the current. The control is effected by two spiral springs as usual. The aluminum disk acts as an eddy current damper, and the astatic arrangement of the coils excludes the effects of external magnetic fields. The weight of the moving parts is about 2 gr., and it is supported in jewel bearings. Experiment has shown that the best winding for voltmeters consists of about 120 turns of thin copper wire, and with this the current con-



FIGS. 4 AND 5.—DIAGRAM OF MOVING-COIL INSTRUMENT.

sumption is about 0.015 amp. Ammeters require a voltage drop of about 0.01 volt so that they can be used economically as shunt instruments for heavy currents.—Lond. *Elec. Engineer*, Nov. 6.

Water Rheostat for Three-Phase Load.—W. L. DURAND.—A description of a water rheostat used in testing a 2200-volt three-phase generator at 225 kw. The lay-out of the rheostat is shown in Fig. 6. A box, 5 ft. in each dimension, was made out of 1-in. pine boards and calked to make it water-tight. This was placed on the ground under the window nearest the switchboard. A 0.75-in. pipe was run from the city water system through the bottom of the box at one side and near the top on

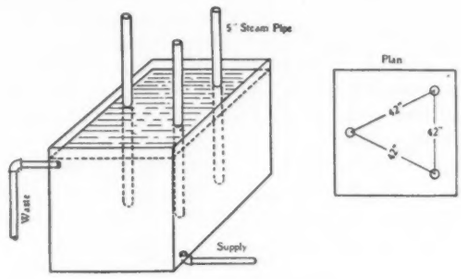


FIG. 6.—WATER RHEOSTAT.

the opposite side a 1-in. drain pipe was placed. A cover with three holes at the corners of a 42-in. equilateral triangle was fastened on the box. In each hole was placed a 5-ft. piece of 5-in. pipe, to one end of which had been soldered a heavy copper wire loop. Each wire was connected to one side of the three-phase circuit by an insulated wire running from the back of the switchboard to the pipe. The pipes were raised and lowered by means of ropes fastened through insulators to the wire loop on the pipes, and running in pulleys held by a temporary framework. The ropes were carried through the window into the power house where they were fastened. During the test the pipes were raised and lowered until the proper load and phase balance were obtained. To determine this, a wattmeter was so connected that the load on any phase could be read. Throughout the whole test the rheostat worked with entire satisfaction, and the closeness with which the load was regulated may be judged by the fact that the average load for the whole test was 226 kw.—*Electric Jour.*, November.

Telegraphy, Telephony and Signals.

Condensers in Telephony.—G. M. B. SHEPHERD.—An article in which the functions of the telephone condenser are classified as follows: (1) As a convenient switchboard and instrument adjunct for differentiating between variable and continuous current. (2) To improve transmission by the well-known quality of capacity for annulling inductance, and extending the range of current changes in speaking circuits. (3) To absorb fluctuations in motor loads, which would otherwise cause disturbances. (4) For various purposes, such as the control of sparking at break contacts, the construction of artificial lines, "and, perhaps, as a matter of scientific interest (for, except in the very early days, no commercial instrument seems to have been attempted) as a telephone receiver." The standard unit in most modern exchange systems on the central-energy principle is the 2-mf. condenser. Various applications of the condensers, for instance, in the common battery instrument of the Western Electric Company, are described and illustrated.—Lond. *Elec. Eng'ing*, Nov. 5.

Miscellaneous.

Austria.—An account of the proceedings at the recent inquiry of the Austrian Department for Public Works concerning legislative questions of electricity supply. The Minister of Public Works, Gessmann, in his speech emphasized the necessity of a law concerning the right of way for electric transmission lines and referred to safety regulations and to the necessity of regulations for the development of water powers. The present inquiry is, however, limited in its compass. A set of questions on legislative subjects has been worked out. These are to be distributed and the answers to be collected and classified. Abstracts are given of the proceedings and of the various propositions offered at the conference.—*Elek. u. Masch.* (Vienna), Nov. 1.

NEW APPARATUS AND APPLIANCES

Mercury Watt-Hour Meters.

The general arrangement of the mercury watt-hour meter illustrated herewith consists essentially of a cylinder or disk-like motor-armature element, partly or entirely submerged in mercury so that electricity may be led in and out from this element by the mercury acting as a contact maker. Electricity passes radially or diametrically across the armature, which is the metallic rotating element, and with a magnetic field properly set with respect to the armature, rotation will result, this rotation being either proportional to ampere-hours or to watt-hours.

In the direct-current meters the main current to the load, or a proportional shunted part thereof, flows directly through the armature of the motor element. The cores of the field magnet are wound with shunt-connected coils, so that the field set up in this magnet by the shunt coil is proportional to the pressure on the circuit. In fact, the direct-current meter is simply a small and delicate direct-current motor, having its armature equivalent to a single turn, and having a field with two air-gaps, similar to an ordinary bi-polar motor. The mercury at the edges of the armature carries current to and from the contacts, these contacts corresponding to the commutator of the usual motor.

The alternating-current meter operates on the same fundamental principle, but the laminated field magnet in the alternating-current meter is energized by a series winding instead of a shunt winding, and the armature is operated from a small "potential" transformer placed inside the meter, the primary of which is connected across the line like the shunt coil of an induction meter. The "potential" transformer delivers a large volume of current to the low-resistance armature circuit. Current to the armature being proportional to the pressure of the circuit, and the field being proportional to the load current, the reaction of the field upon the current through the armature is proportional to the watts, as in the direct-current meter, and the

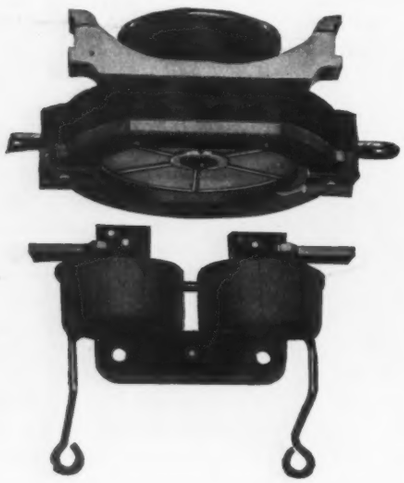


FIG. 1.—MAGNETS AND MOTOR ELEMENT.

rate of rotation of the meter will be a measure of the power and the total number of revolutions will show the energy in watt-hours.

In developing the alternating-current type of meter, the motor element has been improved by eliminating the molded insulation features formerly used for the bottom of the mercury chamber and by adopting a thorough system of doweling all parts of the mercury chamber together, so as to eliminate the possibility of relative changing or shifting of the parts when being assembled. The mercury chamber is provided with a pocket for the mercury to run into when the meter is lying on its side or upside down. The arrangement is similar to that of the invertible inkwell. The armature, or rotating element, has a float so that when immersed in mercury it buoys up the entire rotating system.

The difference between the weight of the rotating system and the buoyancy effect is only about 0.1 oz., which is exerted as an upward pressure against the top bearing jewel. This jewel pressure is claimed to be less than one-fifth of that in any other alternating-current or direct-current meter; as the armature is completely immersed in mercury, pounding or vibration upon the jewel is also much reduced.

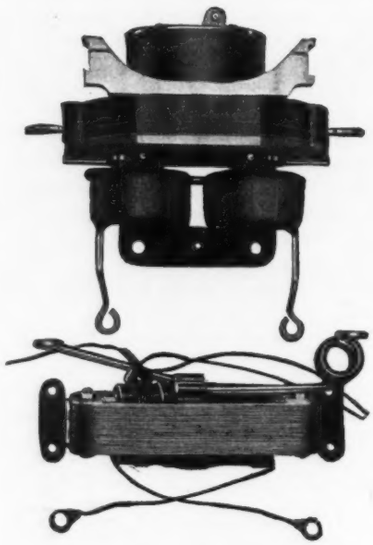


FIG. 2.—MOTOR ELEMENT AND TRANSFORMER.

Meters of large rating are simply 10-amp meters with the series coils operated from a "shunt." The low resistance of the series circuit makes this arrangement possible. It is claimed that by using shunt coils wound with enameled wire instead of silk-covered wire the number of turns obtainable in the space occupied by the shunt coil has been greatly increased, with correspondingly great increase in full-load torque. The full-load torque is said to be approximately 50 mm-grams at full load in 10-amp meters.

Fig. 1 shows the alternating-current meter partially assembled, with the alternating-current laminated magnet carrying the series coils below. Fig. 2 shows the same meter with the magnets in place, and also the transformer mounted inside the case. The complete assembled mechanism in the case, without the cover, is shown in Fig. 3. The small transformer occupies the space back of the laminated magnet so that its heavy secondary winding can be conveniently and permanently connected to the heavy copper contact ears of the mercury chamber. The laminated magnets carry two series coils so that the coils can readily be connected for two-wire or for three-wire operation.

The transformer has a few turns of auxiliary winding, giving a potential of about 0.2 volt, which is used to furnish a small amount of power for light-load compensation. The light-load adjustment provided makes it possible to get zero adjustment for no-load, whether a meter is operated at normal voltage or even at double voltage, as it depends upon the differential action between two cable leads.

The calibration curve of the alternating-current meter is said to be straight, from the lightest loads to very heavy overload.

At 0.1 load the meter shows a variation of not over one-half of 1 per cent for 20 per cent change of voltage from normal. The operation of the meter is said to be practically independent of frequency without any recalibration, there being no difference between 60 and 25 cycles, and an error of only 1.5 per cent at 133 cycles.

The case has been designed to embody the best and most practical features of both glass and metal cases. The sides are formed of trussed sheet steel, and the front is a sheet of extra heavy double-strength glass, held in the case with screw clips and cemented so as to be water-tight and dust-tight.

FIG. 3.—VIEW OF COMPLETE MECHANISM.

A very simple amp-hour meter for direct current, of the same general construction as the direct-current watt-hour meter, but having powerful permanent magnets for energizing the field instead of a potential winding, has been recently perfected for use in measuring the amp-hour input and output of storage batteries in substations, automobiles and steam railroad cars. The mercury watt-hour and amp-hour meters are manufactured by the Sangamo Electric Company, Springfield, Ill.

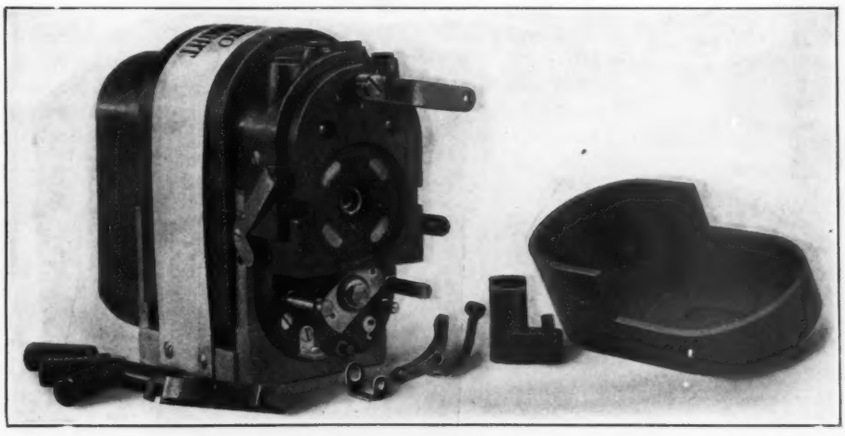
High-Tension Ignition Magneto.

The ignition magneto illustrated herewith is of the high-tension type. It is provided with a secondary winding arranged on a spool separate from the armature, placed directly within the magneto case. There are no connections from the dash to the magneto, and no parts subjected to high voltage reach the surface. The outer surface is smooth and uniform, and there are no projecting parts upon which cleaning-waste may become lodged.

It is claimed that an entirely adequate spark is given by the magneto at a speed as low as 40 r.p.m. It is said that the spark is uniform throughout the whole range of spark advance and retard, which covers the unusually large range of 65 deg.

A shunted spark-gap, which is provided to safeguard the secondary winding, is utilized to indicate and locate trouble. Whenever there is a defect in the electrical circuit, sparks are formed at the shunted gap. When the engine fails to operate and sparks do not appear at the shunted gap, it is safe to assume that the trouble is with the fuel and not with the ignition system.

The above-described magneto has been developed by the Hess-Bright Manufacturing Company, Fairmont Avenue and Twenty-first Street, Philadelphia, Pa.



INTERIOR VIEW OF HIGH-TENSION MAGNETO.

Controllers Using Graphite Resistors.

The controller illustrated herewith differs from the ordinary controller in that for the resistor use is not made of wire, ribbon or grids, and contact segments are not employed. The resistor consists of a column of graphite disks (usually 100 in number), each disk measuring about 1 in. in diameter and ⅛ in. in thickness. These disks are piled upon each other within an insulated iron tube, and the resistance afforded is not in the graphite disks themselves, but arises from the imperfect electrical contact between the several disks. The electrical resistance of such a column of graphite made up of a number of disks, resting upon each other, with no other pressure than their own weight, naturally is very great. An electrical connection is established at both the top and bottom disks of the column, and the flow of electricity from one end to the other of the column meets a very high resistance due to the imperfect electrical contacts between the several disks constituting the column.

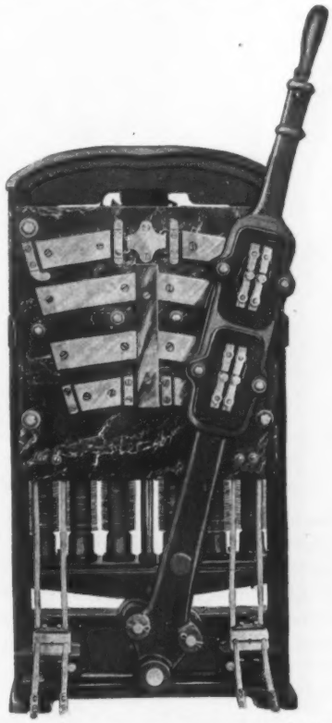


FIG. 1.—FRONT VIEW OF 30-HP CONTROLLER.

When the column is not under external mechanical compression or pressure, its resistance is at its highest, as would be the case, of course, when the operating lever is moved from the "off" or "central" point to the "starting" position. To reduce this high initial resistance, when starting the motor under control, a compression lever, operating in combination with springs, is employed to press the graphite disks together. This action makes the electrical contacts between the several disks so nearly

perfect as to yield practically the equivalent of a solid rod of graphite, with very slight internal resistance. To illustrate specifically, it is stated that a given column of disks not under compression shows a resistance of 110 ohms, whereas the same column under the extreme limit of compression afforded by the controlling lever shows a resistance of only 1 ohm.

The face of the controller presents twin contact plates, the plate on one side being used when the motor is driven forward, the other plate being used when the motor is reversed. The process of reversing the direction of rotation is accomplished by moving the lever from its central neutral position in the opposite direction across the controller face. Each contact plate extends from near the center of the controller face almost to the edge. This plate is made in one unit and is continuous, instead of being formed of segments. By the use of a continuous contact plate, all arcing is eliminated and the renewal of segments is rendered unnecessary.

The rating of the controller, or of the motor with which it may be used, depends upon the number of graphite columns. The front view of a 30-hp controller is given in Fig. 1, while

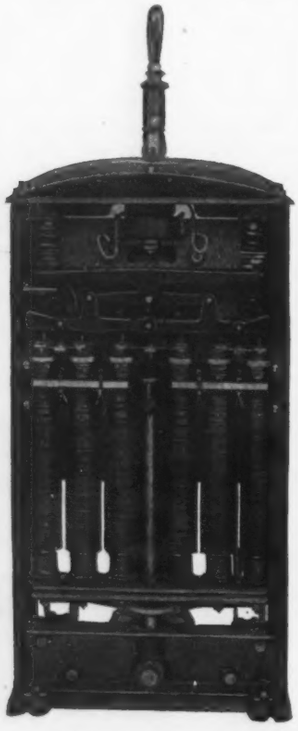
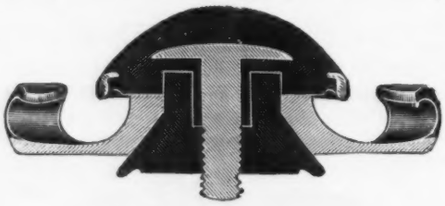


FIG. 2.—REAR VIEW OF 50-HP CONTROLLER.

the rear view of a 50-hp controller is given in Fig. 2. It is claimed that the graphite is not affected by the passage of electricity through it. At no time during service does the temperature reach the value under which the graphite is made, namely, 7000 deg. Fahr. Moreover, the disks are packed in an insulating tube from which air is excluded. It is said that disks that have been in continuous service for three years have shown no signs of deterioration. The controllers are particularly adapted for use with crane motors, although they are employed in a variety of services. They are manufactured by the American Electric Fuse Company, Muskegon, Mich.

New Trolley Hanger.

The trouble arising from the breakage of trolley hangers, both in erection and in actual service, has acted as an incentive to manufacturers of supplies to place on the market a hanger which would combine both mechanical strength and durability with good insulating properties. Even when screwing the cap into place there is always danger of breaking the edges of the cap and thereby lessening the insulating properties of the hanger. About 80 per cent of the breakage, however, results from the slipping off of the trolley, especially when a car is rounding curves. When the trolley comes off it usually happens that before the motorman can stop the car the trolley pole



TROLLEY HANGER.

will strike at least one hanger, often resulting in a broken hanger with its attendant troubles.

As a means of reducing this breakage, the Western Electric Company has recently placed on the market a new hanger, under the trade name of the "Ideal Hanger," which is claimed to prevent such accidents as well as greatly to facilitate the work of erecting the hanger. The cap and cone of this hanger are made of that well-known insulating material "Electrose" and the other parts are of metal. The striking feature of the device, however, is a metallic ring imbedded in the cap. When the hanger is brought into place the strain in applying the wrench comes on this metal ring instead of the edge of the cap. When a trolley pole strikes the hanger, the metal ring sufficiently strengthens it to prevent the breakage common to the ordinary hanger.

Plating Rheostats.

The Ward Leonard Electric Company, of Bronxville, N. Y., has designed a line of plating rheostats for line control. The accompanying cut shows the line rheostat type, which is designed for single-voltage and double-voltage control. The device illustrated is for double-voltage and use on a 5-volt and 10-volt circuit; that is, either on one leg of a three-wire circuit having five volts on each leg, or upon a total of 10 volts. There is a main line switch (fused when so desired), which closed in one direction gives any amperes from 1 amp to 40 amp on 10 volts, and when closed in the opposite direction gives 80 amp on five volts. This gives 31 steps of control on either voltage. Each switch with its resistance is designed to be connected across the full 5 volts or 10 volts respectively. The various number of steps are obtained by using the switches singly or

PLATING RHEOSTAT.

in parallel. As the resistances are designed for the maximum voltage that can be applied upon them, there can be no "burnouts." These rheostats are designed for any capacities and voltages.

Rheostat of Simple Form.

A new rheostat of very simple construction, which makes possible very close adjustment, is being marketed by the Metropolitan Electrical Supply Company, of Chicago. An interior view of this rheostat is shown in Fig. 1. The resistance wire is wound on a circular band and contact with the arm is made

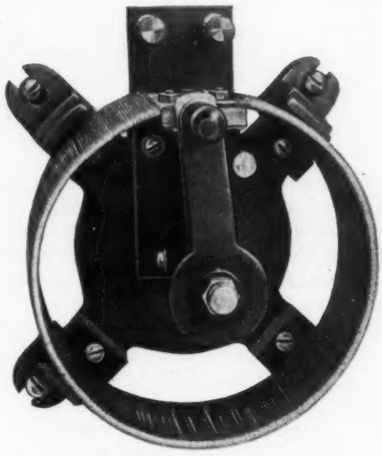


FIG. 1.—INTERIOR VIEW OF RHEOSTAT.

directly against the wire. The exterior view of the rheostat is shown in Fig. 2. This construction gives as many steps of control or regulation as there are turns of wire on the band. There is claimed to be no sparking in passing the lever from one wire to the next on account of the small voltage between turns, and the width of the lever which makes contact upon several turns at the same time. The first point of contact

FIG. 2.—EXTERIOR VIEW OF RHEOSTAT.

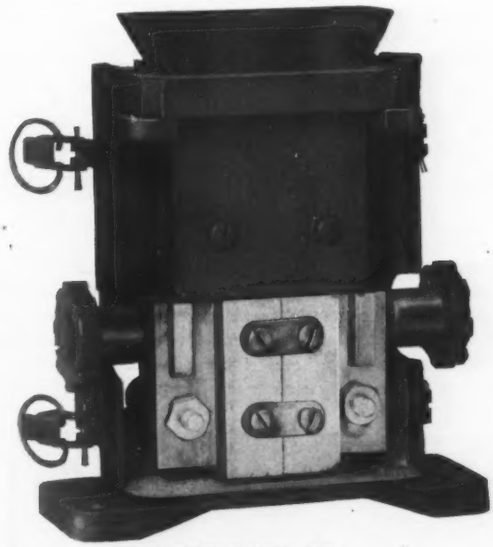
which the lever arm makes is on a post instead of on the wire so that the post takes the sparking when the circuit is broken. All rheostats above 5-amp capacity are provided with a quick-break switch attachment on the lever arm. These rheostats are provided, when desired, with very simple underload and overload release attachments.

Magnetic Fuse Box for Railway Service.

When circuit-breakers were first installed on street cars the motormen regarded them with great favor, and the management has looked with favor on them as they materially reduce the expense for fuses. But gradually the motormen began to find it so easy to throw in the handle of the circuit-breaker that it has become a very frequent occurrence to overload the motor and trip the breaker. This performance is not only unnecessary, but is frequently a cause of fright to the passengers. This careless handling of the controller does more than merely frighten the passengers, for the excessive current produces heavy strains on the motor windings, which may cause injury to the motor. In other words, it has become too easy a matter for the motorman to reset the protective device on his car.

For such reasons large railway companies are equipping their cars with a simple type of fuse in addition to the standard circuit-breaker. A fuse for this purpose has been developed and placed on the market by the Westinghouse Electric & Manufacturing Company; it is a magnetic blow-out form of fuse which overcomes the objections to the use of the old fuse box.

The general arrangement of this fuse box is similar to that of a street-car circuit-breaker in that it has an all-metal case with the live parts entirely enclosed. It is intended to be placed under the car. The main circuit is carried by a short copper strip extending down from the terminals in the form of a loop. This loop passes through an arc-chute, which is supported inside of laminated punchings, thus providing an efficient magnetic blowout. The blowout is produced by the ribbon itself without any exterior coils whatever, as a single turn of the ribbon through the iron circuit provides ample magnetism to blow out the arc formed when the ribbon melts. As shown in the illustration, the fuse box is very compact.



MAGNETIC FUSE BOX.

It is said that the fuse box will carry 400 amp continuously without overheating, while the fuses are rated at from 250 to 600 amp, and are so constructed that they will blow in 30 seconds on 100 per cent excess of this rating. New fuses may be readily inserted by turning the insulating handles on each side of the box without opening the case or using any tools whatever. For the purpose of repairs the sheet-iron front of the box may be removed readily. The arc chute is a single piece and may be replaced readily and cheaply.

Motor-Driven Pumps for Domestic Service.

The pump shown in the accompanying illustration is claimed to be the first successful double-acting small power pump ever made. It pumps twice as much water as a single-acting pump of the same size, it pumps one-fourth more water than the triplex single-acting pump of the same size and it costs less to operate per gallon delivered both in energy consumption and in interest on the original cost than does either of the other pumps. Friction in this pump has been reduced to the minimum and it operates, therefore, with a minimum of energy. Instead of having three bearings for the crank shaft, three connecting rods with bearings at either end and three large plungers to be kept packed, as is the case with triplex single-acting pumps,

the pump has only two bearings, two connecting rods, and only two small stuffing boxes for piston rods to be kept packed.

In the construction of these pumps use is made of cast-steel crankshafts, bronze connecting rods, brass piston rods, brass plunger, working cylinders and iron plungers. It is claimed they have been designed not only for pressures up to 150 lb.

MOTOR-DRIVEN PUMP.

per square inch, but for great suction lift, and they will successfully draw water a vertical distance of 25 ft., a performance that is remarkable for small pumps of this same general type.

These pumps have been placed on the market by the Sanitary Pump Company, 10 South Canal Street, Dayton, Ohio.

Electric Furnace for Annealing and Tempering.

To secure the best results in the process of annealing and hardening it is necessary above all to have a uniform temperature throughout the furnace. The coal and gas furnaces of today by no means fulfill this requirement on account of the large furnace area exposed to the air for radiation. Moreover, to obtain the best results it is often necessary to adjust the tempera-

FIG. 1.—ELECTRIC FURNACE AND CONTROL APPARATUS.

ture of the furnace, and this cannot be done with any precision with the gas furnace.

In the type of electric furnace now being manufactured by the General Electric Company, for operation on alternating-current circuits, metallic salts are reduced to a liquid state by means of an electric current. It can be readily seen that as soon as these salts reach a liquid condition the temperature can be regulated by varying the amount of current passing through the bath. By this method of regulation any temperature will remain uniform throughout the bath except at the surface, where it is slightly lower, due to radiation.

In Fig. 1 is shown an electric furnace outfit as installed in the die department of the Schenectady works of the above company. The outfit, as can be seen, consists of the furnace, with its hood suspended from above; the regulating transformer with regulating switch; the switchboard with the necessary ammeter and voltmeter; the incoming line with fuses. The regulating switch is provided with a sufficient number of contact points to give, as stated before, almost any desired temperature between the limits of 250 deg. C. and 1350 deg. C.

The furnace, a sectional view of which is shown in Fig. 2, consists of a fire-clay crucible surrounded by an insulating material, usually of asbestos, which rests in a fire-clay box, all being supported by an enclosing case of iron. Two suitable electrodes, connected to the low-tension side of the transformer, are placed on each side of the crucible and are in direct contact with the bath at all times.

In using the furnace an arc is first started across the broken flux by means of an auxiliary electrode and in a very short time the solid mass is in a molten condition. After the bath has reached its proper temperature, that portion of the material to be hardened is submerged in the liquid bath and is allowed to remain there until it attains the same color as the bath, when it is removed and tempered in water or oil, as the case may be.

The bath for hardening or annealing, which completely fills

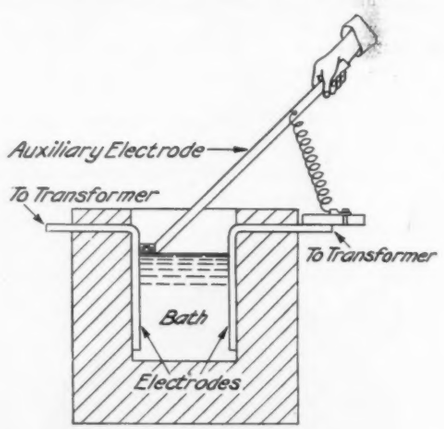


FIG. 2.—SECTIONAL VIEW OF ELECTRIC FURNACE.

the crucible in the Schenectady factory, consists of equal portions of barium chloride and potassium chloride. The ultimate temperature depends on the relative proportions of the two chlorides, the higher the percentage of barium chloride the higher the temperature may be carried.

In addition to hardening, the furnace may be used for softening tempered steel, the bath being maintained at a temperature of about 250 deg. C. for this work.

The following advantages are claimed for this type of electric furnace: There is no chance for oxidation, for the material while being heated does not come in contact with the air. All parts of the tool are subjected to the same temperature at all times, thus preventing any possibility of strains or overheating. Its high efficiency and low cost of operation place it far above the gas furnace. There is practically no danger from fire as the outer walls of the furnace are never hot; in fact, when the bath has a temperature of 1300 deg. C. the hand can be placed on the outside of the furnace without being burned. It is so simple and requires so little care and attention that it can be operated by an ordinary workman. The metallic salts have no effect on the composition of the steel and the operator never comes in contact with dangerous fumes as in the cyanide bath.

The above-described furnace is particularly useful in the manufacture of machine tools, automobiles, razors, knives, firearms, jewelry, fine instruments, etc.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

In general terms it is safe to say that the extension of trade in commercial lines is continuing in a most satisfactory manner. The volume of sales and of orders booked by wholesalers and by manufacturers continues to show gains. This is particularly true in the North and East where the restriction of trade for the past few months has been more keenly felt than in the South and West. The continued mild weather has, in a measure, retarded the sale of heavy wearing apparel, and it is probable that there will not be much more done in this line until next year. The Christmas holiday trade shows a distinct improvement, and this line of business is being done principally on rush orders. Cotton goods are growing in demand and prices are being advanced over the low levels that have prevailed for the past year. The Fall River print mills claim that they are sold up to the first of the year. There is a better sale for cotton yarn and the mills of the South especially report sufficient orders to keep all of the spindles busy for many months. There is more doing in the leather and shoe business, and orders from retailers in these lines are very heavy. Crude rubber sold during the week at the highest prices ever known, but it is pretty well understood that this is the result of speculation, and it is not considered a favorable symptom for the rubber manufacturing trade. Lumber still continues to be in good demand and there is a general, though gradual, revival in the building industry. This is especially true in the South and Northwest. In industrial centers additional employees are being put to work daily. Encouraging reports come from the Pittsburgh district, and it is confidently believed that by March all branches of manufacture in this section will be operating at normal capacity. The number of idle cars is growing smaller every day, and by January it is expected that the reports of the equipment departments will indicate shortages instead of surplus. Railway gross earnings, although much better than they were during the summer, still, as a rule, show decreases from the same period last year. These decreases, however, are at a much smaller percentage than those of a few months ago. Net receipts, on the other hand, in many instances, show gains, due, of course, to the rigid economy that the period of depression has taught the railroad managers. There was more activity in pig iron last week than any time since June, although prices have not as yet been advanced. The bulk of the purchases were made by the open-hearth steel works. There were few orders made for heavy steel rails, but the mills report large number of inquiries. Commodity prices were steady and in some instances slightly higher. Raw cotton was slightly advanced in price, but it has not yet reached a figure sufficiently high to induce the planters of the South to market their crops with freedom. Business failures for the week, as reported by *Bradstreet's*, numbered 273, compared with 267 the week previous, 265 in 1907, 212 in 1906, 224 in 1905, and 193 in 1904.

THE COPPER MARKET.

During the past week the copper market has been very dull and prices have displayed a downward tendency. During the latter half of October and the first half of November, there were tremendous domestic takings of copper. While the claim of the producers, that they are very closely sold out for spot delivery, may or may not be true, there is little reason to doubt that consumers in this country are very well stocked. The result of such a condition is that while there is but a slight pressure to sell there is an entire absence of eagerness to buy. During the week sales of electrolytic, for December and January delivery, were made at 14 cents, a concession from previous prices, and it is claimed that more metal was offered at that figure than consumers would take. It cannot be denied that the majority of consumers expect further concessions in prices, and are willing to buy only to bill their immediate needs. They understand thoroughly the unfavorable statistical position, and are unconvinced by the continued protestations of the selling agencies that there is no surplus stock. The production of copper goes on with unabated vigor, and the belief that stocks are accumulating is unavoidable. The output from domestic ores is now estimated at 90,000,000 lb. monthly, and with the imports of ore and matte from Canada, Mexico and South America the total refined is fully 110,000,000 lb. each month. The development of the new fields in this country has not yet been fully realized and possibly 10,000,000 lb. per month more will be produced unless production is artificially restrained. Consumption, on the other hand, is about 75 per cent of normal, and gives little indication of increase before next spring. The total exports for the month, including Nov. 23, were 15,223 tons. Prices quoted on the Metal Exchange on that date were:

Lake	14¼ @ 14⅜
Electrolytic	14 @ 14⅛
Castings	13⅞ @ 14

The London market was as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	62 12 6	62 15 0
Standard copper, futures	63 12 6	63 12 6
Market	Easy.	Quiet.
Sales of spot		300 tons
Sales of futures		1,000 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Lake copper, spot	14½	12⅜
Electrolytic copper, spot	14⅜	12¼
Casting copper, spot	14¼	12⅛
London, spot	£64 17 6	£56 5 0
London, futures	65 15 0	56 17 0
London, best selected	68 10 0	60 0 0

GENERAL ELECTRIC CONTRACTS.—The General Electric Company reports that the following orders for railway apparatus have been recently received: Seattle Electric Company, Seattle, Wash.—Fifty four-motor GE-80 (40 hp) car equipments; four 1000-kw motor-generator sets converting 60-cycle, 13,200-volt current into 600-volt direct current. These machines are provided with direct-connected exciters, the switchboard being included in the order. Four 100-kw, 60-cycle, 13,200-volt air-blast transformers with blowers. Denver City Tramway Company, Denver, Col.—Two 500-kw, 25-cycle rotary converters; seven 185-kw oil-cooled transformers. Sioux City Traction Company, Sioux City, Iowa.—Thirty 30-hp railway motors. Washington Water Power Company, Spokane, Wash.—Twenty four-motor, 40-hp car equipments; two four-motor 75-hp car equipments, with Sprague-General Electric type "M" control. Pittsburgh Railways Company, Pittsburgh, Pa.—One 400-kw, direct-current engine-driven generator; three 200-kw, 60-cycle rotary converters. Western New York Construction Company, Buffalo, N. Y.—Eight four-motor, 75-hp commutating-pole car equipments, with Sprague-General Electric type "M" control.

WESTINGHOUSE COMPANY GETS RECORD TRANSFORMER CONTRACT.—The Southern Power Company, of Charlotte, N. C., has just awarded to the Westinghouse Electric & Manufacturing Company, through the New York district office, one of the largest orders for transformers ever placed. This contract calls for transformers aggregating 93,000 kw and involves in the aggregate about $350,000. The transformers will range in sizes from 1000 kw to 4000 kw, with a uniform pressure of 100,000 volts. The apparatus will be used on the transmission line of the Southern Power Company between Charlotte, Greensboro and Greenville, covering an area of 240 miles. The company obtains its power from several large plants on the Catawba River and is used to supply power to all the cotton mills in the Piedmont district. The Southern Power Company's system of power transmission is one of the largest in the world, approximating about 200,000 hp.

POWER PLANT FOR KANSAS.—The Minneapolis Steel & Machinery Company has secured the contract to install a new power plant for the Manhattan City & Interurban Railway Company, of Manhattan, Kan. The equipment will include an 18x36-in. heavy duty Twin City Corliss engine, two 66-in. x 18-ft. horizontal return tubular boilers, one 200-kw direct-current generator, switchboard, feed water heater and purifier, boiler feed pump, etc.

CONDUIT MANUFACTURERS BUSY.—The manufacturers of conduits and conduit material report an increase in business, which for the time being is very satisfactory, but which promises to grow in the future into handsome proportions. The conduit business, of course, is a trifle slower than other construction lines to feel the effects of the business revival from the fact that conduits are among the last features to be installed in new work. The conditions, however, are exceedingly promising. The American Conduit Company, through Mr. W. W. Grant, says: "Business is much better and the outlook for good times in the spring is very fine. Even during the dull period the company has lost no money, and at the present time inquiries are plentiful." Mr. B. S. Barnard, of the Standard Vitrified Conduit Company, says: "We have kept our factories busy during the dull times and now things are looking much brighter for active business. We have recently taken big contracts for Cuba, the city of Philadelphia, and several good contracts in the New England States. We have turned down orders at the old prices and the advance on Dec. 1 will average fully 20 per cent over the prices in September. B. S. Barnard & Company is also doing good business both in the East and West. They recently made large contracts with the Chicago Edison Company, the Chicago City Railway Company, the cities of Milwaukee and Minneapolis and with the Detroit Tunnel Company." The interior conduit business is also looking up. R. B. Cory says: "We note considerable improvement which is coming gradually in our business. Of course, we are among the last to feel it because new buildings which have been contemplated are just beginning to go forward. We believe we will be overrun by next spring." The Sprague Electric Company also reports an increase in business, but said that this did not wait until the election, as early in the fall orders began to look up. There has been a steady growth of building, especially in the South, and this company has had its full share. It says the supply houses all over the country seem to be stocking up.

CROCKER-WHEELER COMPANY EQUIP TEXTILE MILL.—Another large textile mill has closed a contract with the Crocker-Wheeler Company for the installation of electric-drive machinery. The concern is the Windham Manufacturing Company, of Willimantic, Conn., which has just ordered a complete electric power plant, including motors, transformers and switchboards. The equipment consists of nine 550-volt squirrel-cage induction motors, aggregating about 500 hp, which will be used to drive the machinery in the mill. The generating equipment consists of two 500-kva, 600-r.p.m. generators. The current will be generated at 600 volts, 60 cycles, three-phase, and will be transformed to 110 volts for lighting. The motors are all arranged for ceiling suspension. The transformers for the lighting system and the switchboard were also furnished by the Crocker-Wheeler Company.

LARGE CONTRACT FOR AUTOMOBILE SPARK COILS.—The Cadillac Motor Car Company, of Detroit, Mich., has recently awarded to the Jacobson-Brandow Company, of Pittsfield, Mass., a contract for 10,000 spark coils. These coils will cost upward of $150,000, and their delivery extends over a year. Under the terms of the contract the deliveries of the coils shall increase from the present figures, 15 per day, up to 30 per day, which will be the maximum. The Jacobson-Brandow Company is only about a year old, but has forged to the front rapidly. In addition to the coils, the concern is making a combination lock switch for automobiles and a new magneto switch in connection with the spark coils.

CURTIS LOW-PRESSURE TURBINES.—The General Electric Company has begun to push the sale of the Curtis steam turbine for low-pressure service. At the present time the General Electric Company has sold seven low-pressure turbines aggregating 12,000 hp and 1300 ordinary turbines aggregating 1,500,000 hp. The operating economy of the new form is well shown by the experience of the Philadelphia Rapid Transit Company. One of this company's power plants, already equipped with 8200 hp in Wetherell-Corliss engines, had a 2100-hp low-pressure turbine installed. The saving in the first year's operation is stated to be about $120,000, or 50 per cent more than the cost of the turbine.

TELEPHONY IN BRAZIL.—Messrs. Guinle & Company, of Rio de Janeiro, who are prominently identified with electrical development in Brazil, have recently secured a decree authorizing them to take over a concession granted to E. P. Wilson for the installation and operation of a telephone system in the large city of Bahia.

THE ACME WIRE COMPANY, of New Haven, Conn., has acquired real estate on Dixwell Avenue, that city, to be used as the site for a new plant. An architect has been instructed to draw plans for the development. The main factory will be a four-story structure, and the new factory as a whole will exemplify the latest and best ideas of safe, solid and suitable construction.

Financial Intelligence.

THE WEEK IN WALL STREET.

Owing to the very practical reason that there were more people who wanted to sell securities in Wall Street during the past week than there were who wanted to buy securities, prices have had a sagging tendency and the net changes for the week have been in the main declines. It began to be evident early in the week that the remarkable amount of outside buying which had been going on since the election was beginning to fall off. Orders were not so many and there was no insistence upon having securities regardless of the market price. On the other hand, the pressure to sell, while not at all alarming, was steady. It seems to be the general impression that a large portion of the heavy lines of securities, accumulated during the spring and summer by insiders at prices very much lower than those which have prevailed recently, were being offered to the public. Whether this is true or not there were certainly plenty of sellers and the majority of these were profit-takers. Such a condition is not at all surprising. Many lines of stocks have recently been sold which have been carried in the banks and in private vaults for more than six months. It is not unnatural that these should come into the market when they can be sold at from 15 to 30 points advance. The only trouble to be apprehended from this character of sales is that if recent buyers who are outsiders find that their purchases represent losses at market quotations the outside desire to acquire stocks may entirely disappear. It has been a long time since the public was really interested in the Wall Street market, and it would be a pity if its newborn confidence should be shaken by a serious reaction. Fortunately, however, there seems to be only the legitimate selling of the actual holders of stock. So far there is no evidence that any bear campaign has been planned. So long as this is the case the market can be expected to, in a measure, follow the laws of supply and demand. It is also intimated that when prices have gone down a bit further those interests which have recently let go at high figures will be buyers again. This will, of course, offer further encouragement to public investment. In the meantime there has been a steady progress in the business world, both in

NEW YORK.

	Nov. 17.	Nov. 23.	Shares Sold.		Nov. 17.	Nov. 23.	Shares Sold.
All.-Ch.	13⅞	14	14,225	Int.-Met., pfd.	36¼	34	22,955
All.-Ch., pfd.	47⅜	48	8,800	Mackay Cos.	77	76	1,250
Amal. Cop.	86¼	82½	202,825	Mackay Cos., pfd.	70½*	70¾*	365
Am. D. T.	35*	35*	———	Manhattan Elev.	144	142	4,625
Am. Loc.	56⅛	54½	13,200	Met. St. Ry.	33½	30¾*	850
Am. Loc., pfd.	110	109*	1,307	N.Y. & N.J.Tel.	120*	122*	100
Am. Tel. & Cble.	75½	—	100	Steel, com.	57½	54	721,010
Am. T. & T.	132	130⅞	24,125	Steel, pfd.	113⅞	112⅝	24,015
B. R. T.	56¼	53¼	77,885	W. U. T.	65	65¼	6,400
Gen. Elec.	155	153½	6,100	West'h., com.	92	91¾	17,020
Int.-Met., com.	13⅞	13¾	72,040	West'h., pfd.	120	119*	200

PHILADELPHIA.

	Nov. 17.	Nov. 23.	Shares Sold.		Nov. 17.	Nov. 23.	Shares Sold.
Am. Rys.	46	46*	———	Phila. Elec.	12⅛	11¾	———
Elec. Co. of A.	10⅞	10¾*	———	Phila. R. T.	21⅞	22⅜	———
Elec. Stor. B'ty.	41	41	———	Phila. Traction.	89*	89	———
E. S. B'ty, pfd.	49*	49*	———	Union Traction.	50	49⅞	———

CHICAGO.

	Nov. 17.	Nov. 23.	Shares Sold.		Nov. 17.	Nov. 23.	Shares Sold.
Chi. City Ry.	176*	176*	———	Chi .Tel. Co.	127	127*	———
Chi. Rys., Ser.1.	110*	110*	———	Met. El., com.	13*	13*	———
Chi. Rys., Ser.2.	46¼	45	———	Nat'nal Carbon.	83	83*	———
Com. Edison.	108¼	107½	———	Nat. Carb., pfd.	110¼	113	———
Chi. Subway.	23⅜	21¾	———				

BOSTON.

	Nov. 17.	Nov. 23.	Shares Sold.		Nov. 17.	Nov. 23.	Shares Sold.
Am. Tel. & Tel.	132½	131	———	Mass. F. R., pfd.	56¾	58	———
Com'bind Tel.	122*	122*	———	Mex. Tel.	3	3	———
Gen. Elec.	156	154	———	Mex. Tel., pfd.	5½*	5½*	———
Edison El. Ill.	247½	250¼	———	N. E. Tel'p.	126	127*	———
Mass. Elec. Ry.	12	11¾	———	W. Tel. & Tel.	9½	9⅛	———
				W. T. & T., pfd.	78½*	78½	———

*Last price quoted.
Shares sold are for week Nov. 16 to Nov. 21.

commerce and in manufactures, there has been a gradual improvement shown in railroad earnings and all of these things help to bring the condition of business up to the level upon which the stock market has been trading for months. It has been generally recognized that stocks have been too high to be on a parity with business conditions. It now appears that the prices of stocks may pause while business catches up. The money market has been a trifle stiffer owing, no doubt, to the large bond issues which have recently been offered. These have been taken care of without any disturbance whatever, and the price of money has advanced but a small fraction. The demand is a little brisker and quotations are a trifle higher. On Nov. 23 call money ranged from 1¼@2 per cent, and 90-day paper was quoted at 3¼@3½ per cent. The quotations in the table are those of the close Nov. 23.

DIVIDENDS.

Chicago (Ill.) Telephone Company, common, 2 per cent, quarterly, payable Dec. 31, 1908.

Pressed Steel Car Company, preferred, quarterly, 1¾ per cent, payable Nov. 25.

St. Joseph, Railway, Light, Heat & Power Company, St. Joseph, Mo., common, quarterly, 1 per cent, payable Dec. 1, 1908.

United States Steel Corporation, common, quarterly, ½ per cent, payable Dec. 30.

Kansas City Railway & Light Company, Kansas City, Mo., common, quarterly, $2 per share, payable Jan. 15, 1909.

General Electric Company, common, quarterly, $2 per share, payable Jan. 15, 1909.

Rochester Railway & Light Company, Rochester, N. Y., preferred, quarterly, 1¼ per cent, payable Dec. 1.

Mobile (Ala.) Electric Company, preferred, quarterly, 1½ per cent, paid Nov. 16.

VIRGINIA PUBLIC SERVICE CORPORATION.—The report of Special Master W. C. L. Taliaferro in the Federal Court receivership of the Public Service Corporation of Virginia's lighting plant and properties at Hampton and Phoebus, Va., filed at Norfolk, Va., shows a total indebtedness by the corporation of $179,511, outside of $300,000 in stock and $125,000 conditional guarantee on the bonds of the Suffolk Gas Company. The assets of the corporation are placed at $112,112 plus $15,927 held to be due by J. A. Barham and Walter Whetstone on alleged broken contract. In the matter of priorities of liabilities the special master reports in the following order: Liens and taxes, $365.90; repaving, $700.52; receivers' certificates, $2,500; open account debts, $4,580.57; Columbia Trust Company, trustee, $128.14. Total, $8,275.13. Bonds to the amount of $150,000 and then unsecured claims of $21,236.60. Next would come the $300,000 in stock conditioned upon the Suffolk Gas bonds guarantee of $125,000. Walter Whetstone, Philadelphia, the receiver, has been cited to appear before Judge Waddill at Norfolk, Dec. 7 to show cause why an injunction should not be issued restraining him and Clarence H. Wildes from disposing of $100,000 in bonds of the Public Service Commission.

HUDSON RIVER ELECTRIC COMPANY BONDHOLDERS' COMMITTEE.—Default having been made in the payment of interest due Nov. 1, 1908, on the $3,000,000 first mortgage 5-per-cent gold bonds, and in view of the appointment of receivers of the company, the following protective committee has requested the deposit of these bonds on or before Dec. 1, 1908, with the Morton Trust Company, New York City, as depositary, or with the West End Trust Company, Philadelphia, or Commonwealth Trust Company, Boston, as agents: H. M. Francis, New York; Peter Boyd, Philadelphia; Albert L. Scott, Boston; J. I. Burke, secretary, 38 Nassau Street, New York. Parker, Hatch & Sheehan, of New York, and Gaston, Snow & Saltonstall, of Boston, are counsel for the committee.

CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY.—The annual report of the Consolidated Gas, Electric Light & Power Company, of Baltimore, shows that the income of the company in excess of operating expenses and taxes for the fiscal year ended June 30 last was $1,870,085; fixed charges were $1,234,586, leaving a net balance applicable to dividends on the stock of $635,499, which equals about 3½ per cent on the common stock after regular preferred dividend is paid. The net income for previous fiscal year was $630,257. Owing to the general business depression, the output of gas for the year was only slightly in excess of that of the previous year, but the output of electric current for the same period increased about 10 per cent.

REORGANIZATON PLAN OF CONSOLIDATED RAILWAY, LIGHTING & REFRIGERATING COMPANY.—The reorganization plan of the Consolidated Railway, Lighting & Refrigerating Company contemplates the purchase at receiver's sale of the assets of the company. If all the assets of the company are bought a new company will be organized, with $8,000,000 authorized capital stock, the par value of shares being $25. Each share of the old stock deposited and paying the 25 cents assessment will be exchanged for one share of new stock, which will be issued as only $24.25 paid up, the remaining 75 cents to be paid at such time as the directors of the company may determine.

NARRAGANSETT ELECTRIC LIGHTING COMPANY.—A circular announces that at a special meeting of the stockholders held on Nov. 12, it was voted to issue $500,000 "debenture certificates bearing interest at the rate of 4 per cent per annum, payable quarterly on the first days of April, July, October and January of each year, for 10,000 shares of the capital stock of said company at $50 per share." These debenture certificates will be redeemed by the company in stock on Jan. 1, 1913, or sooner at the option of the directors. Every stockholder of record Dec. 1, 1908, will be entitled to subscribe for one new debenture (par $50) for every eight shares of his present holdings.

VACUUM CLEANER COMPANY.—Messrs. H. B. Hollins, R. W. de Forest and J. B. Dunn, reorganization committee, have issued notice of a plan for the future of the Vacuum Cleaner Company, which has been in difficulties, but has a good plant and business in New York. The new company, it is proposed, will have a capital of $375,000 preferred stock and $375,000 common, to be in the hands of a voting trust for two years. The preferred stock is entitled to cumulative dividends at the rate of 6 per cent per annum.

CATARACT POWER & CONDUIT COMPANY BOND ISSUE.—The Cataract Power & Conduit Company, Buffalo, N. Y., controlled by the Niagara Falls Power Company, through ownership of more than 50 per cent of the $2,000,000 capital stock, recently obtained authority to sell at not less than 90 $120,000 30-year 5 per cent sinking gold bonds of $1,000 each, secured by the first mortgage dated Jan. 1, 1897. The proceeds will be used for additions and improvements.

PETITION FOR RECEIVER FOR THE EMPIRE STATE COMPANY.—A petition has been filed in United States Court by Amsterdam creditors of the Empire State Company, of Glens Falls, which supplies electricity to the Mohawk Valley towns, asking that the company be declared bankrupt. This concern is a subsidiary of the Hudson River Power Company, which was recently placed in receivers' hands owing to the failure of Gay & Company, of Boston, Mass.

PORT JERVIS ELECTRIC LIGHT, GAS, POWER & RAILROAD COMPANY.—Justice Morschauer, of the Supreme Court of New York, has appointed James G. Graham, Newburg, referee to compute the amount due on the mortgage held by the Knickerbocker Trust Company, New York, as trustees for the bondholders of the company in the matter of proceedings for foreclosure and sale already instituted.

BOSTON (MASS.) ELEVATED RAILWAY.—A call for a special meeting of stockholders of the Boston Elevated Railway to be held Nov. 18, 1908, has been issued. Stockholders are asked to approve an issue of $7,000,000 new stocks and determine the price at which the new shares shall be sold. The proceeds of the issue will be used to meet the expense of building the proposed Cambridge subway.

UNION GAS & ELECTRIC COMPANY, CINCINNATI.—No action, it is stated, was taken by the company on its preferred stock dividends for July and October, "It having been deemed best on account of the industrial situation to defer the distribution." The dividend is cumulative. The preferred stock outstanding amounts to $5,000,000.

CINCINNATI & SUBURBAN BELL TELEPHONE.—The Cincinnati & Suburban Bell Telephone Company, Cincinnati, Ohio, has decided to increase outstanding capital through the issuance of $282,500 treasury stock to stockholders at par at the ratio of one share for every 24 held.

MILLIKEN BROS. RECEIVERSHIP EXTENDED.—Judge Holt, in the United States Circuit Court, has granted an extension of the receivership of Milliken Brothers, New York, to Jan. 2, 1909.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Telephone & Telegraph Company, New York:					
October, 1908	$3,895,223	$164,305	$3,730,918	$666,100	$3,064,809
October, 1907	3,499,239	134,960	3,364,279	795,572	2,568,707
Brockton & Plymouth (Mass.) Street Railway Company:					
September, 1908	12,603	6,678	5,925	1,833	4,092
September, 1907	11,620	8,450	3,170	2,222	948
Cape Breton Electric Company, Ltd., Sydney, N. S.:					
September, 1908	22,006	11,706	10,301	4,961	5,339
September, 1907	23,671	12,278	11,393	4,862	6,532
Dallas (Tex.) Electric Corporation:					
September, 1908	95,842	63,080	32,762	27,956	4,806
September, 1907	95,632	63,669	31,963	28,390	3,573
Duluth (Minn.) Street Railway:					
October, 1908	78,730	45,927	32,803	18,917	13,887
October, 1907	74,508	41,461	33,047	17,919	15,128
East St. Louis (Ill.) Suburban Company:					
October, 1908	178,644	90,804	87,841	.....	.....
October, 1907	206,014	97,085	108,929	.....	.....
Edison Electric Illuminating Company of Brockton, Mass.:					
September, 1908	16,471	8,952	7,520	3,268	4,252
September, 1907	17,296	9,024	8,272	1,560	6,712
Electric Light & Power Company of Abington & Rockland, Me.:					
September, 1908	4,791	3,014	1,776	328	1,449
September, 1907	4,504	2,939	1,565	592	973
El Paso (Tex.) Electric Company:					
September, 1908	43,828	33,338	10,490	7,133	3,357
September, 1907	45,556	31,172	14,384	5,956	8,428
Galveston-Houston (Tex.) Electric Company:					
September, 1908	91,790	46,620	45,170	20,121	25,050
September, 1907	97,651	52,942	44,709	19,495	25,214
Houghton County Electric Light Company, Houghton, Mich.:					
September, 1908	19,749	9,761	9,988	4,494	5,494
September, 1907	19,681	9,811	9,870	3,455	6,415
Houghton County Traction Company, Houghton, Mich.:					
September, 1908	23,934	11,801	12,133	4,963	7,170
September, 1907	23,878	12,023	11,856	4,798	7,057
Jacksonville (Fla.) Electric Company:					
September, 1908	34,017	18,372	15,645	9,032	6,613
September, 1907	32,651	19,621	13,030	7,829	5,201
Lowell (Mass.) Electric Light Corporation:					
September, 1908	26,328	16,139	10,190	3,365	6,824
September, 1907	28,250	15,946	12,304	3,485	8,819
Milwaukee (Wis.) Electric Railway & Light Company:					
October, 1908	338,442	165,955	172,487	100,560	71,928
October, 1907	338,049	179,645	158,404	101,063	57,340
Milwaukee (Wis.) Light, Heat & Traction Company:					
October, 1908	112,675	30,560	82,115	58,858	23,258
October, 1907	112,499	31,910	80,589	56,967	23,623
Minneapolis (Minn.) General Electric Company:					
September, 1908	81,898	34,413	47,485	32,310	15,175
September, 1907	76,108	37,223	38,885	26,628	12,257
Montreal (Que.) Street Railway:					
October, 1908	328,608	168,124	160,484	27,480	133,003
October, 1907	311,898	164,575	147,323	27,868	119,455
Northern Ohio Traction & Light Company, Akron, Ohio:					
October, 1908	157,532	90,258	67,274	43,779	23,495
October, 1907	155,291	92,701	62,590	43,369	19,221
Northern Texas Electric Company, Fort Worth, Tex.:					
September, 1908	88,190	49,316	38,874	15,216	23,658
September, 1907	93,468	50,153	43,315	13,776	29,539
Puget Sound Electric Railway, Tacoma, Wash.:					
September, 1908	148,861	95,983	52,878	43,372	9,506
September, 1907	147,150	92,403	54,747	40,163	14,583
Seattle (Wash.) Electric Company:					
September, 1908	385,946	209,952	175,994	93,345	82,694
September, 1907	359,423	209,729	149,694	82,884	66,810
Tampa (Fla.) Electric Company:					
September, 1908	43,356	26,705	16,652	4,538	12,114
September, 1907	43,079	32,153	10,925	638	10,287
United Railways of St. Louis, Mo.:					
October, 1908	949,914	572,325	377,589	233,846	143,743
October, 1907	971,322	607,450	363,872	231,483	132,389
Whatcom County Railway & Light Company, Bellingham, Wash.:					
September, 1908	28,381	17,363	11,018	*8,945	2,072
September, 1907	29,033	17,049	11,984	7,529	4,455

*Note.—Taxes increased $1,200 in order to include in year 1908 the recent adjustment and increase of taxes by State Board of Tax Commissioners.

GENERAL NEWS

Construction News.

GADSDEN, ALA.—The Alabama Power Company, which was incorporated for the purpose of developing the water-power of the Coosa River to generate electricity for lighting and other purposes, has filed plans and specifications with the Secretary of State.

RUSSELLVILLE, ARK.—The Russellville Water & Light Company, recently incorporated to take over the water and light plant at Russellville, will commence work on the construction of an electric light plant and water works system, the cost of which is estimated at $100,000. The company has already awarded a contract for the construction of a dam across the Illinois River. The pumps and other machinery will be operated by water power. The plant will furnish electricity for lamps and motors for cities and towns within a radius of 20 miles of Russellville. The offices of the company will be located in Pine Bluff, Ark. A. Brewster is president of the company.

VAN BUREN, ARK.—W. R. Petty, of Pine Bluff, Ark., is reported to be interested in a project to establish an electric light plant at Van Buren.

LOS ANGELES, CAL.—The Edison Electric Company of Los Angeles is planning extensive improvements and extensions to its system, which will involve an expenditure of $1,000,000, and will include the erection of a 30,000-volt high-tension transmission line from Inglewood to Long Beach.

POMONA, CAL.—The Home Telephone Company has ordered a new telephone switchboard to be placed in the exchange at Claremont, and is also planning to install a new exchange at San Dimas.

SAN JOSE, CAL.—Bids will be received by the board of managers of the Agnews State Hospital, San Jose, Cal., until Dec. 16 for furnishing and installing a complete power plant and conduit system, as follows: First, for furnishing boilers, including all boiler room auxiliaries, steam piping, etc.; second, engine; third, generator and switchboard; fourth, underground reinforced concrete conduit system; fifth, underground piping, electric conduit and electric wiring. Plans and specifications may be seen at the office of Sellon & Hemmings, state architects, 804 Kearney Street, San Francisco, Cal., or at Agnews State Hospital, Agnews, Cal., and at the office of the board of managers, 7 West Santa Clara Street, San Jose, Cal. Full information will be furnished by W. M. Sontheimer, secretary of the board.

STOCKTON, CAL.—The Stockton Terminal & Eastern Railroad Company is making arrangements to let contracts for the construction of its road early in 1909. The railway will be about 30 miles in length. W. H. Newell is president and chief engineer.

STONINGTON, CONN.—The American Velvet Company has closed its plant for the purpose of equipping its mill for electric operation. Steam power will not be discarded entirely, however.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 1 for furnishing at the various navy yards and naval stations the following supplies: Portsmouth, N. H.: Schedule 597—770 lb. seamless copper pipe, 3000 lb. seamless drawn brass tubing, etc. Boston, Mass.: Schedule 613—40,000 lb. manganese bronze, 7100 lb. seamless drawn copper pipe, etc. Brooklyn, N. Y.: Schedule 593—Four induction coils, magnet wire, 1500 lb. insulating cotton tape, etc. Schedule 612—3000 ft. wire rope, 1500 lb. brass rod, 10,975 lb. seamless drawn brass tubing, etc. Norfolk, Va.: Schedule 591—9000 incandescent lamps, 54 electric soldering irons, etc. Annapolis, Md.: Schedule 598—2000 ft. conduit steel, miscellaneous wire, etc. Bids will also be received until Dec. 8 as follows: Mare Island, Cal.: Schedule 575—Six indicators for main engine cylinders, etc. Puget Sound, Wash.: Schedule 573—Annunciators, 3200 lb. soft rolled copper, 10,000 ft. braided indicator cord, etc. E. B. Rogers is paymaster general.

WHITE SPRINGS, FLA.—Plans and specifications are being prepared by D. G. Zeigler & Company, of Atlanta, Ga., for the construction of a large power plant on the Suwanee River, near White Oaks, by the Suwanee River Railroad & Power Company, contracts for the construction of which, it is said, will be awarded about Dec. 15. It is proposed to develop about 25,000 hp, at a cost of about $3,000,000.

DAWSON, GA.—The Dawson Telephone Company, recently incorporated, has purchased the plant and holdings of the Georgia & Alabama Telephone Company and will take possession Dec. 1. The new company proposes to install a new switchboard and erect additional telephone lines into rural districts.

MADISON, GA.—The Madison Milling & Manufacturing Company contemplates the construction of a laundry to be operated in connection with its ice plant, and may install an electric motor.

WADLEY, GA.—R. L. Perkins has been granted a franchise to construct and operate an electric light plant and water works system in Wadley. Electricity will be generated at his mill, located near Wadley. The plant of the Wadley Yellow Pine Company has been leased by Mr. Perkins.

SANDPOINT, IDAHO.—It is stated that contracts will be awarded in January by the Pend d'Oreille Electric Company for the construction of a large power plant, the cost of which is estimated at $400,000. The equipment will include water wheels, generators, switchboards, transformers, water wheel governors, high voltage insulators, etc. The water power of Moyea Falls will be utilized to furnish power for the plant. H. M. Byllesby & Co., Chicago, Ill., are engineers. J. F. Reynaud is manager of the company.

AURORA, ILL.—The property of the Aurora, De Kalb & Rockford Electric Traction Company will be sold at auction by John S. Sears, master in chancery, at Geneva, Ill., on Nov. 30. The company operates an electric railway from Aurora through Kaneville and Maple Park to De Kalb, about 30 miles in length.

RIDOTT, ILL.—It is reported that Fred Ridott contemplates establishing an electric light plant and will petition the town officials for a franchise.

TROWBRIDGE, ILL.—The capital stock of the Trowbridge Mutual Telephone Company has been increased from $1,500 to $3,000.

HAGERSTOWN, IND.—The municipal electric light plant has been rendered practically useless by the Hagerstown Natural Gas Company shutting off the supply of gas at the electric light plant. The Town Board of Trustees has made arrangements with the Light Inspection Car Company to connect its pipes with the plant. As the last-named company will not be able to furnish sufficient power to operate the entire plant, it is expected that the street lighting service will be discontinued through the winter.

LIGONIER, IND.—Municipal ownership of the lighting system in this city was defeated Nov. 1.

LINTON, IND.—The City Council has decided to make improvements to the municipal lighting plant at an expenditure of $15,000.

MULBERRY, IND.—The Town Board has decided to establish a municipal electric light plant, plans for which are now being prepared.

RIVER PARK, IND.—The Town Board has granted a 50-year franchise to the Indiana & Michigan Electric Company to extend its wires to supply electricity for street and commercial lighting and motors.

SCOTTSBURG, IND.—C. W. Kelley, of Jeffersonville, Ind., has procured a franchise to build and equip an electric light plant and a water works plant in this city. Mr. Kelley is in the market for material and electrical equipment.

SULLIVAN, IND.—It is reported that J. W. Broady and associates, of Indianapolis, Ind., have procured a site near the Linton Fourth Vein Coal Mine in Curry Township on which to erect and equip a large central plant to generate electricity for transmission to Indianapolis, Anderson, Crawfordsville, Marion and New Castle for power purposes.

DAVENPORT, IA.—Plans are being prepared by the People's Light Company for extensive additions and improvements to its plant in Davenport next year, which will involve an expenditure of about $200,000. The company also contemplates making improvements to its systems in Rock Island and Moline, for which plans and estimates are now being prepared.

BALDWIN, KAN.—The citizens recently voted to issue $35,000 in bonds, the proceeds to be used to install a water works system, to be operated in connection with the municipal electric light plant. E. P. Knapp is superintendent of the municipal electric plant.

NEWTON, KAN.—A. M. Rose and Olcott Payne, of New York, N. Y., have been in the city recently making investigations, with a view of establishing an electric plant. It is proposed to furnish electricity not only for Newton, but also for adjoining towns and villages for both lamps and motors. The promoters are also interested in the project to construct an electric railway extending to Wichita and to Saline, with lines connecting with Hesston and Moundridge and other nearby towns.

FRANKLIN, KY.—The Franklin Electric & Ice Company, recently incorporated, is making arrangements to erect a power plant, for which electrical machinery and equipment has already been ordered.

DELHI, LA.—The City Council is considering the question of establishing an electric light plant and water works system in Delhi.

BANGOR, MAINE.—Electricity for operating the street railway system of the Bangor Railway & Electric Company is now furnished from the hydro-electric plant of the Bar Harbor & Union River Power Company, at Ellsworth. Two generators have thus far been installed in the plant, furnishing 2500 hp. With the installation of additional machinery, 10,000 hp can be developed.

PORTLAND, MAINE.—All the property and holdings of the Northeastern Telephone Company will be sold at public auction, at its office in Portland, Maine, Dec. 16, by Frank E. Ebersole as special master, by a decree of foreclosure.

SOUTH BERWICK, MAINE.—The Berwick & Salmon Falls Electric Company has petitioned for a location for its transmission lines over the

highway from the end of Great Works Bridge to the Boston & Maine Railroad Station at Conway Junction.

BALTIMORE, MD.—The Board of Estimates has refused to appropriate $150,000 for the installation of an independent plant for heating and lighting the city hall and court house, as recommended by Building Inspector Preston.

AMHERST, MASS.—The Amherst Gas Company has applied to the State Board of Gas and Electric Light Commissioners for permission to increase its capital stock by $40,000, the proceeds to be used to take up outstanding notes for $29,000 and for the cancellation of indebtedness incurred in installing new boilers, electrical equipment and extension of lines.

MARLBORO, MASS.—The Board of Aldermen has voted to extend the contract with the Marlboro Electric Company for lighting the streets of the city from five to eight years, making the contract expire in 1913 instead of 1910, in consideration for which the company agrees to replace the 25-cp incandescent street lamps now in use with 40-cp tungsten lamps throughout the entire city without additional cost.

SALEM, MASS.—The Mosser Leather Company is installing electric equipment to furnish electricity for 700 lamps. J. Browns & Sons are also installing machines for the same purpose. Tigh & Osborn, of Goodhue Street, have recently installed an electric plant to furnish electricity for about 500 lamps. Stanley & Townsend, electricians, are furnishing equipment and installing the above plants.

TAUNTON, MASS.—The Globe Manufacturing Company has installed a new generator in its factory. The company will furnish electricity to the Twist Drill Company and to the Dudley Shuttle Works in the same building.

WALTHAM, MASS.—A petition has been filed with the State Board of Railroad Commissioners asking for a certificate that public necessity and convenience require the construction of an interurban electric railway from Waltham to Marlboro, to connect at Waltham with the Newton Street Railway system and thence with the Boston Elevated Railway and with the Boston & Worcester Street Railway at Marlboro. The railway is to be 22½ miles in length, and the capital stock is placed at $500,000. The directors are: Fred T. Ley, of Springfield, Mass.; P. P. Adams, of Waltham, Mass.; Harold A. Ley and Morris H. Barnett, of Springfield, Mass., and F. R. S. Mildon, of Marlboro, Mass.

WARE, MASS.—The Otis Company is making arrangements to install an electric generating plant in its mills to furnish additional power. A 750-kw turbine engine will be installed. At present the mills are operated by water and steam power. The cost of the plant is estimated at $40,000.

WAREHAM, MASS.—The citizens are considering the question of establishing a municipal electric light plant.

BAY CITY, MICH.—It is reported that L. H. McHenry, representing the Eastern Michigan Power Company, which is developing the water power of the Ausable River for electrical purposes, has submitted a proposition to the City Council for street lighting and will also make application for a franchise. The company proposes eventually to furnish electricity in Saginaw, Au Sable, Osceola, West Branch, Grayling, Gaylord, Standish, Alpena and other towns.

BELLEVUE, MICH.—The Council has granted a franchise to the Michigan Power Company to furnish electricity to light the streets of the town and for residential and commercial lighting. The town has been without street lighting service for over a year.

CHEBOYGAN, MICH.—The Eastern Michigan Power Company, which will develop the power of the Au Sable River, has secured 90 per cent of the land needed for flowage rights. It is proposed to build 10 or 12 dams within a distance of 100 miles on the river. Electricity for lamps and motors will be offered to every city within a radius of 200 miles.

DETROIT, MICH.—Sealed proposals will be received at the office of the Public Lighting Commission, No. 40 Atwater Street, East Detroit, Mich., until Nov. 30 for furnishing the commission with arc lamps, copper wire, cross arms and cedar poles, in accordance with specifications on file in the office of the commission. F. T. Fowler is secretary of the commission.

GRAND RAPIDS, MICH.—Two leading business streets of this city are now lighted by series of electric arches. The system has proved so satisfactory and the cost of installation so moderate that it has been decided to place arches on other streets leading from the main business section of the city. The cost of installation is in all instances paid by property owners.

LESLIE, MICH.—The Council has granted a franchise to the Michigan United Railways Company to operate its railway through Leslie.

MENOMINEE, MICH.—The Menominee & Marinette Light & Traction Company is reported to have awarded contracts for equipment of its power plant at Grand Rapids as Follows: For water turbines, with a total rating of 4250 hp, and four Lombard automatic governors, to the Globe Iron Works, of Dayton, Ohio; generators, transformers, switchboards, etc., to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa.

ONAWAY, MICH.—Merritt Chandler, of this city, is interested in a project to develop the power of the Black River from Tower to a point 20 miles or more above that village and has control practically of the needed flowage rights. Mr. Chandler proposes to furnish electricity to all the cities below Cheboygan to a point reached by the Au Sable power.

ALEXANDRIA, MINN.—It is reported that the City Council will purchase a complete arc lighting system according to specifications made by Edward P. Burch, of Minneapolis, Minn., consulting engineer.

FERGUS FALLS, MINN.—The power house and dam of the municipal electric light plant has been completed at a cost of about $60,000. The new plant will be able to furnish all electricity required for lamps in the city and have a large surplus besides. The rate for electricity for lighting is to be reduced on Jan. 1 from 10 cents per kw-hour to 5 cents per kw-hour. The Council is considering the question of heating the city hall and city lockup and using the surplus energy in other ways.

HASTINGS, MINN.—The City Council has granted the Hastings Telephone Company a franchise to construct and operate a telephone system in this city.

MINNEOTA, MINN.—A company has been organized to construct a rural telephone line from Minneota to Nordland. C. K. Melby is president, and L. S. Teigland, secretary.

MOORHEAD, MINN.—Peter Prins, of this city, and George Van Sickle, of Fargo, N. D., are organizing a company with a capital stock of $50,000 for the purpose of establishing and constructing power plants in the Northwest. Peter Prins is president of the company, and A. M. Van Sickle is secretary and treasurer. The company will begin at once the construction of a light and power plant at Lakota, N. D.

ROCHESTER, MINN.—The citizens are considering the question of a bond issue of from $50,000 to $75,000 for improvements and additions to the municipal electric lighting plant.

THIEF RIVER FALLS, MINN.—Plans are being made by the Farmers' Mutual Telephone Company to extend its telephone lines in the vicinity of Rocksbury.

CARL JUNCTION, MO.—The local business men are considering the question of installing an electric system in the town. It is proposed to secure electrical energy from the Joplin-Pittsburg Electric Railway, which passes through Carl Junction.

COLUMBIA, MO.—Preliminary surveys are being made for an electric railway from Columbia, Mo., to Ashland, Mo., which is the proposed extension of the Mexico, Perry & Santa Fe Traction Company, of Mexico, Mo., now under consideration. M. G. Quinn, of Mexico, Mo., is manager.

DILLON, MONT.—The Queen of the Hills Mining Company is preparing to erect a 15-stamp mill and concentrating plant at its mine. The company has entered into a contract with the Andrews Light & Power Company, of Salmon, Idaho, for electricity to operate the machinery in both the mill and mine. The power company is now making surveys for extending its transmission line to the property. Emerson Hill is superintendent of the mine.

BROCK, NEB.—J. W. Bailey, of Auburn, Neb., is making arrangements to install a private electric lighting system and will install a dynamo and engine in his plant.

OAKLAND, NEB.—The citizens have voted to grant the New State Telephone Company permission to install a telephone system and exchange in Oakland.

ROUND MOUNTAIN, NEV.—The Nevada-California Power Company, of Goldfield, Nev., contemplates extending its transmission lines to Round Mountain and Manhattan to furnish electricity as soon as the extensions to the Bishop Creek plant are completed. The company also plans to furnish electrical energy for Hornsilver and other camps in the southern country. Delos A. Chappell is president of the company.

JERSEY CITY, N. J.—The Board of Aldermen on Nov. 17 passed an ordinance granting permission to the Mutual Benefit Electric Light, Heat & Power Company to install an underground conduit system for the distribution of electricity for lamps and motors in Jersey City.

NEWARK, N. J.—The Prudential Insurance Company is awarding contracts for the construction of a large office building to be erected in Newark, which will include the equipment for an electrical power plant with an output of 2500 hp and other electrical machinery, including 16 passenger elevators.

PLEASANTVILLE, N. J.—The bondholders, who purchased the property of the Atlantic City & Suburban Traction Company at a foreclosure sale Oct. 31 for $91,000, will reorganize the company under the name of the Atlantic & Suburban Railway Company. Robert Wetherill, of Chester, Pa., is chairman of the bondholders committee.

ALBANY, N. Y.—The New York Central Railroad Company is making extensive additions to the power house at its West Albany shops, which will double the output of the plant. Eight new boilers and a complete equipment of electric generating machinery will be installed. The plant will furnish electricity to light the shops.

BERGEN, N. Y.—A petition has been presented to the Village Board asking that a special election be held to vote on the proposition to authorize an expenditure of $6,000 to complete and improve the present electric lighting system.

ELMIRA, N. Y.—Charles Georgia, electrical contractor, has been awarded the contract for installing the electrical equipment in the enlarged American-La France Fire Engine Company's plant in Elmira, which includes motors, switches, wiring, etc.

GENEVA, N. Y.—H. B. Sweet, electrical engineer, employed by the special committee of the Common Council to make a report on the probable cost of establishing a municipal pole line, has submitted his report to the committee. Three plans were recommended in the report: The first

provided that the city own the pole line and sublet to other companies; the second that the city erect a pole line for its own use, and the third that the city and the other companies use the poles now in existence. The third proposition was selected by the committee as the best. The estimated cost of a pole line under the third proposition is placed at $16,576. The city is now paying $10,500 per year for street lighting. Two bids have already been received by the committee for furnishing electricity to be delivered at the city switchboard. The Economic Power & Construction Company offers to furnish transformer and electrical energy at the rate of 1¼ cents per kw-hour. The Empire Coke Company offers to deliver electricity at 1½ cents per kw-hour at a switchboard to be located at the corner of North and Preemption Streets.

GOWANDA, N. Y.—Bids will be received by the State Commission in Lunacy, Albany, N. Y., until Dec. 3 for furnishing engine and dynamo and underground electric feeders from power house to superintendent's residence and staff house at the Gowanda State Homeopathic Hospital, Gowanda, N. Y. Drawings and specifications may be seen and blank proposal forms obtained at the Gowanda State Homeopathic Hospital, Gowanda, and at the office of the State architect, Albany, N. Y. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to, and in the discretion of, Franklin B. Ware, State architect, Albany, N. Y. T. E. McGarr is secretary of State Commission in Lunacy.

JAMESTOWN, N. Y.—The Board of Lighting Commissioners has placed an order with the General Electric Company, of Schenectady, N. Y., for a turbo-generator exciter and a 30-hp motor for the municipal electric light plant.

NEW YORK, N. Y.—Plans have been filed by Church E. Gates & Co. for the construction of a power house at 138th Street and Fourth Avenue, to cost approximately $50,000.

NEW YORK, N. Y.—W. F. Hulse, 30 Church Street, New York, N. Y., is securing estimates of the cost of electrical equipment for a power plant with a rating of 400 kw, to be installed at Arden Farm, a country estate of E. H. Harriman.

NEW YORK, N. Y.—Bids will be received until Dec. 2 by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., for furnishing all material and labor for complete conduiting, electric wiring and all other work in connection with the installation of a complete electric lighting and power system for certain buildings and grounds on Blackwell's Island. Robert W. Hebberd is commissioner.

SYRACUSE, N. Y.—The contract for installing the heating and power plant in the Onondaga County Hospital buildings has been awarded to Thomas E. Gildea, of Syracuse, N. Y., for $23,743. It is said that Mr. Gildea will install the piping and sublet contracts for equipment, including three 150-hp horizontal tubular boilers, two 100-kw generating units, two 150-hp high-speed engines, one 35-kw generating unit, one 52½ high-speed engine, and generators direct connected; pumps, switchboard and other accessories.

NEW YORK, N. Y.—The Public Service Commission has granted the Pelham Park Railroad Company and the City Island Railroad Company permission to substitute a monorail line to be operated by electricity for its old horse car systems. The companies operate cars from City Island to Bartow Station on the New York, New Haven & Hartford Railroad, a distance of about three miles. The line will be constructed by the American Monorail Company. If the system is successful the company plans to apply for franchises for extension of the system throughout the Bronx and Westchester County. Bion L. Burrows is president.

ONEONTA, N. Y.—The Citizens' Light, Power & Heating Company, recently organized, is endeavoring to secure the electric street lighting contract for a term of five years in opposition to the Oneonta Light & Power Company, which now holds contract, and if successful will establish a plant here at once, to be ready to furnish electricity by March 1, when the present contract expires. The matter will be decided at the next meeting of the Board.

ROCHESTER, N. Y.—Arrangements are being made to install an electric plant in the Baker Theater. The cost of the plant is estimated at $3,200.

ROCHESTER, N. Y.—The new transformer station of the Rochester Railway & Light Company in Elmwood Avenue, No. 33, is rapidly nearing completion, and the company will soon install three additional transformers, to reduce the current received from Niagara Falls from 60,000 to 11,000 volts. It is stated that another low-pressure steam turbine and two 800-kw generators will be required at Station No. 4. The company is planning to install a 2500-kw frequency changer in order to switch from Niagara 60-cycle, alternating-current to the local 25-cycle system. T. H. Yawger is superintendent of the electrical department.

SYRACUSE, N. Y.—Plans are being prepared for a 200-room annex to the Yates Hotel, Syracuse, which will include an electric generating plant, the equipment of which will include two boilers, two direct-connected generating units attached to high-speed engines, boiler feed and circulating pumps, refrigerating plant and other accessories. It is said that bids will be called for in January.

UTICA, N. Y.—Application has been made to Judge George W. Ray, in United States District Court, by the receivers of the Hudson River Power Company, asking that the contract between the Oneida Railway Company and the Utica & Mohawk Valley Railway Company be abrogated; also to annul the contract between the city of Oneida and the Hudson River Power Company. The application is made on the plea that the power company is furnishing electricity to the above parties at a loss.

WARWICK, N. Y.—The Warwick Valley Light & Power Company is making arrangements to increase the output of its plant and has contracted for a new 400-hp engine. H. P. Barber is president.

WATERTOWN, N. Y.—C. D. Hodge & Company, of Watertown, N. Y., have secured the contract for the erection of the Jefferson County Telephone Company's Building on Stone Street. The necessary exchange apparatus has been ordered and will be installed as soon as the building is in readiness.

CHARLOTTE, N. C.—It is reported that work will soon be resumed at Ninety-nine Islands by the Southern Power Company. The plant owned by the company at Gaston Shoals is inadequate to meet the demands made upon it.

CHARLOTTE, N. C.—The management of the Jewell cotton mill has announced that work will begin at once on the construction of its new fine-combed yarn plant. The building will be 300 ft. long and will be equipped to be operated by electricity. W. W. Hagood is president, W. A. Watson vice-president and T. L. Lillard secretary and treasurer.

FAYETTEVILLE, N. C.—R. G. Harrison, of Fayetteville, N. C., would like to receive prices and catalogues on knitting machines and electrical equipment for driving the same.

MAXTON, N. C.—The Carolina Electric Company is in the market for a 75-kw, three-phase, 60-cycle, 2300-volt generator; also a 20-hp, three-phase, 60-cycle motor, new or second hand, and would like to receive prices on the same.

RALEIGH, N. C.—Improvements have been completed at the Buckhorn Falls power plant, and it is expected to place the plant in operation shortly. It is said that the cotton factories in Raleigh will begin to use electricity from this plant about Dec. 1, 1908.

SANFORD, N. C.—It is reported that specifications are being prepared for a substation to be erected by the Carolina Light & Power Company (successor to the Central Carolina Power Company) in Sanford, for the transmission of electrical energy from the hydro-electric plant at Buckhorn Falls, on Cape Fear River, to Sanford. Electricity will be supplied for street lighting in Sanford and to manufacturing plants.

WINSTON-SALEM, N. C.—The Fries Manufacturing & Power Company has entered into a contract with the Southern Power Company to extend its transmission lines to Winston-Salem. The Southern Power Company is to furnish the Fries Manufacturing & Power Company 1500 hp by July 1, 1909. The transmission line will be extended by the way of Lexington, High Point and Greensboro.

DRAPER, N. D.—Plans are being made to extend the Farmers' Telephone line 14 miles north of Draper at once.

BUCYRUS, OHIO.—The bond issue recently voted by the citizens for the construction of a municipal electric light plant has been enjoined. Several bids were received for the bonds, but were not opened.

COVINGTON, OHIO.—The Council has granted the Covington Home Telephone Company a franchise to operate and maintain a telephone system in Covington.

DAYTON, OHIO.—Bids will be received by the Board of Education of the City of Dayton, Ohio, until Dec. 10, 1908, for furnishing one 125-hp reciprocating engine and one 75-hp turbine engine, direct connected to generator of same rating as engine, with switchboard, etc., complete, installed ready for use. Plans and specifications on file in the office of the superintendent of buildings, Dayton, Ohio. O. J. Needham is president of board.

FINDLAY, OHIO.—The Board of Service has rejected three bids for lighting the streets of Findlay, claiming that they are too high.

LIMA, OHIO.—The City Council has refused to accept the plans and specifications for a municipal lighting plant as prepared by an engineer employed by the Board of Public Service. The board threatens to go on with the erection of the plant anyway and claims it has full power to do so, in which case injunction proceedings would likely follow.

MT. VERNON, OHIO.—The property of the Mt. Vernon Railway & Light Company, including the street railway system, electric light plant and Lake Hiawatha Park, an amusement park, were sold at receivers' sale Nov. 7, to P. B. Chase, of Washington, D. C. The price paid for the property is said to have been $40,400.

TOLEDO, OHIO.—F. Bissell & Company, of Toledo, Ohio, are reported to be looking for a suitable location for a new factory. The firm will require about three acres of land, and when the proper site is found a factory that will employ about 400 people will be erected. It is the intention to manufacture electrical machinery, switchboards and motors for sewing machines.

WARREN, OHIO.—Articles of agreement for the consolidation of the Warren Gas Light Company and the Hyde Electric Company have been filed with the Secretary of State at Columbus. The new merger will be known as the Hyde Electric & Gas Company.

ANTLERS, OKLA.—The city contemplates establishing an electric light plant, and has secured an engineer to prepare plans and estimates.

ENID, OKLA.—Hamlin Sawyer, of Enid, has petitioned the City Council for a franchise to construct an electric railway in Enid. The road will connect Enid with Breckenridge, Garber, Cropper and Billings.

MINCO, OKLA.—It is reported that the city will be in the market

for equipment for an electric light plant about Jan. 1. J. C. Kinzey is mayor.

EUGENE, ORE.—Arrangements are being made to construct a municipal power plant in Eugene, at a cost of about $130,000, bids for the construction of which will be received in about 30 days. Frank C. Kelsey, 415 Corbett Building, Portland, Ore., is engineer in charge of the work.

HOOD RIVER, ORE.—Application has been made to the City Council for a franchise to construct and operate an electric railway in Hood River by H. B. Langille, secretary of the Upper Hood River Valley Development League. C. A. Bell, proprietor of the Mount Hood Hotel, has also applied for a franchise to build an electric street car line.

NEWBERG, ORE.—The Yamhill Electric Company contemplates installing a new boiler plant. C. J. Edwards is president and manager.

PANAMA.—Bids will be received at the office of the general purchasing officer of Isthmian Canal Commission until Dec. 14 for furnishing boilers, with stacks, breeching, uptakes and fittings, surface condenser, generator and engine, brake rod, connection pins, etc. Blanks and general information relating to this circular (No. 481) may be obtained at the above office or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing agent.

BEAVER FALLS, PA.—The City Council has awarded the contract for lighting the streets and public buildings of the city with electricity to the Beaver Valley Electric Company for five years. The company is to furnish 90 or more arc lamps of 1200 cp at the rate of $65 per lamp per year; incandescent electric lamps of 25 cp at $1.50 per lamp per month, and 50-cp incandescent lamps at $2.40 each per month.

CARLISLE, PA.—The Cumberland Railway Company has increased its capital stock to $282,000 and the amount of its bonds to $300,000.

CONNEAUTVILLE, PA.—Edward B. Fish and E. H. Fisher, both of Conneautville, have applied to the City Council for a franchise to erect an electric light plant in this city, and furnish electricity for both street, commercial and residential lighting in Conneautville and Springboro.

JOHNSTOWN, PA.—The Southern Cambria Railway Company has been granted permission to make several extensions to its system, including the construction of a railway to Woodvale Heights, a branch to South Fork, and an extension to the Jefferson Township line.

MONONGAHELA, PA.—The Monongahela & Carroll Street Railway Company has awarded the contract for the construction of its railway from Monongahela to Ellsworth, a distance of 14 miles, to Pihl & Miller, of Pittsburg, Pa. Later contracts will be awarded for the construction of the remainder of the road, extending through Washington, which will be 14 miles in length. George M. Hosack, of Pittsburg, Pa., is president.

PHILADELPHIA, PA.—The Chester County Electric Company, it is reported, is planning to make improvements to its power plant at Kennett Square, at an expenditure of about $20,000. E. W. Meloney, of Avondale, is superintendent.

PHILADELPHIA, PA.—Only one proposal was received for lighting the city for the year 1909, which was submitted by the Philadelphia Electric Company. Its prices range from 25 to 28 cents per lamp per night, according to location. There are at present 12,000 electric lamps throughout the city. The cost of maintenance for 1909 will be $1,182,791.

PINE GROVE, PA.—The question of establishing a municipal electric light plant is under consideration by the Town Council.

PITTSBURG, PA.—The Pittsburg Railways Company is erecting a substation at Castle Shannon, containing two 400-kw motor generator sets, and a substation at Cannonsburg, the equipment of which will include three 200-kw rotaries and a transformer station at the southern terminus of the Mt. Washington tunnel, Pittsburg, for a 22,000-volt, aerial high-tension transmission service. The General Electric Company, of Schenectady, N. Y., is supplying the equipment for these stations.

SPRINGBORO, PA.—Application has been made to the Council by Edward B. Fish and E. H. Fisher, both of Conneautville, Pa., for a franchise to furnish electricity for street and commercial lighting.

WAYNESBORO, PA.—The Hagerstown Railway Company, of Hagerstown, Md., is contemplating the construction of an electric railway through Martinsburg, W. Va., which will cross the Potomac River at Williams Street.

LEWISBURG, TENN.—The Lewisburg Light & Power Company, it is reported, will purchase the municipal electric light plant and will install an ice manufacturing and cold storage plant and make other improvements. The company will also take over the outstanding bonds amounting to $6,000.

ALVIN, TEX.—E. B. Hill, who was recently granted a franchise by the City Council to erect and operate an electric light plant in this city, has made arrangements for the construction of the plant and has already placed contracts for electrical machinery and equipment for the system.

BELTON, TEX.—The Southwestern Telephone & Telegraph Company has been granted a franchise by the City Council to install underground conduits for its wires in this city.

GALVESTON, TEX.—The question of installing new engines at the municipal electric light plant is under consideration by the Board of City Commissioners.

SABINAL, TEX.—The capital stock of the Sabinal Water & Ice Company has been increased from $20,000 to $28,000. The company proposes to furnish electricity for lamps and motors.

TERRELL, TEX.—The city is planning to establish a municipal electric light plant, for which $15,000 in bonds will be issued.

ROANOKE, VA.—The Brown Abattoir Company, recently incorporated, will establish an abattoir and install an electrically driven refrigerating plant, orders for which have been placed with the Automatic Refrigerating Company, of Hartford, Conn.

WALLINGFORD, VT.—The Rutland Railway, Light & Power Company is considering the question of extending its transmission lines to this village if sufficient patronage can be secured to pay for the extension.

DAYTON, WASH.—Plans are being considered for the construction of a large power plant on the Tukanon River 15 miles above Dayton, which will furnish electrical energy to operate an electric railway from Dayton, Wash., to Walla Walla, Wash.

SEATTLE, WASH.—Application for franchises to construct eight miles of subways in the business and adjoining residence districts have been made to the City Council by Etlinger & Company, of London, Eng., and Charles A. De Benditty, of Amsterdam. The plans provide for an expenditure of $6,000,000.

SPOKANE, WASH.—Plans are being considered by the Pacific Telephone & Telegraph Company for extensions and improvements to the local telephone system, which will involve an expenditure of over $1,000,000. It is proposed to establish three additional exchanges in the city.

TACOMA, WASH.—The City Council has decided to call a special election during December to vote upon a bond issue for the construction of a municipal power plant. The plant is to be located on the upper Nisqually River, 32 miles southeast of Tacoma, at a cost of $2,000,000 and will develop 20,000 hp. The initial bond issue will be $300,000 to pay for surveys, right of way and site.

MADISON, WIS.—The Capitol Commission has awarded the contract for electrical fixtures, wiring, conduiting for telephone system and power system for the east wing of the Capitol to Paul F. Harloff, of Madison, Wis., for $14,560.

MILWAUKEE, WIS.—The committee appointed by the Greater Milwaukee Association to look into the question of the better lighting of business streets is considering a plan whereby the Milwaukee Electric Railway & Light Company may furnish electroliers complete, providing the property owners meet the cost of illumination. It is proposed to set three electroliers to each block.

PEWAUKEE, WIS.—The Milwaukee Western Electric Railway Company has applied to the Village Board for a franchise to operate its railway through Pewaukee. The railway will run from Milwaukee to Beaver Dam.

WALWORTH, WIS.—The Chicago, Harvard & Geneva Lake Railway Company is planning to install a 250-hp water tube boiler in its local power house. H. H. Windsor is manager.

BELLA COOLA, B. C., CAN.—B. F. Jacobson, of this town, is endeavoring to arrange for the construction of a local and rural telephone system.

WINNIPEG, MAN., CAN.—The Manitoba Telephone Commission is arranging to connect its system with that of the Saskatchewan Government.

WINNIPEG, MAN., CAN.—H. N. Ruttan, city engineer, has recommended to the Fire, Water and Light Committee that electrical power be substituted for steam power at the civic pumping station, thereby saving a large sum annually.

CHATHAM, ONT., CAN.—The Chatham, Wallaceburg & Lake Erie Railway Company has decided to extend its railway from Wallaceburg to Dresden and Thamesville next summer.

PORT ARTHUR, ONT., CAN.—The sheriff has seized the municipal street railway formerly owned by this city and operating in Fort William and has turned it over to the joint commission appointed to manage the system. A protest has been entered by the ratepayers, who claim the system was sold without putting the question to the ratepayers in a by-law. A committee is now being formed to override the action of the City Council and get back the system.

WALLACEBURG, ONT., CAN.—It has been definitely announced that the Chatham & Wallaceburg Electric Street Railway Company will extend its line from Wallaceburg to Dresden and Thamesville.

WINDSOR, ONT., CAN.—At an election soon to be held the citizens will vote on the proposition to authorize an expenditure of from $25,000 to $30,000 for the reconstruction of the municipal electric light plant. The question of purchasing electrical energy from the Hydro-Electric Commission is also under consideration.

ST. LAMBERT, QUE., CAN.—A franchise has been granted to the Montreal & Southern Counties Railway Company to operate an electric railway to the subway under the Grand Trunk Railroad track to the southern boundary of the town limits. The by-law will be submitted to a vote of the people for final ratification.

TORREON, MEXICO.—A syndicate of wealthy Chinamen are building an electric railway system in this city and an interurban line that will connect Torreon with the town of Matamoros. The system will have about 20 miles of track. The syndicate is operating under the name of the Compania Bancaria y de Tranvias Wah Yick. A Chinese bank is operated here by the same interests.

New Industrial Companies.

THE DOE BATTERY COMPANY, of Kent, Ohio, has been incorporated, with a capital stock of $100,000, by M. J. Hubbell and others.

THE ELECTRIC WATER PURIFYING COMPANY, of Denver, Col., has been incorporated with a capital stock of $25,000 by N. G. Burnham, J. J. Crippen and F. J. Spencer, of Denver, Col.

THE HEANEY LAMP COMPANY, of Portland, Me., has been incorporated with a capital stock of $3,000,000 to manufacture incandescent lamps. C. E. Eaton is president, and T. L. Croteau, treasurer, both of Portland, Me.

ELECTRO-AUTOMATIC DISPLAY COMPANY, has filed articles of incorporation with the Secretary of State at Dover, Del. The incorporators are: R. C. Morris, G. T. Woods, E. R. Drake, H. L. Means, of Louisville, Ky.

THE BELL ARC LIGHT COMPANY, of Brooklyn, N. Y., has been chartered, with a capital stock of $100,000, by Charles A. Campbell, of Brooklyn, N. Y.; Monroe May, of New York, N. Y., and Henry W. Van Allen, of Brooklyn, N. Y.

THE DAVIS ELECTRIC SALES COMPANY has filed articles of incorporation, with a capital stock of $200,000, with the Secretary of State at Dover, Del. The incorporators are: F. W. Mills, H. M. Browne and E. J. Farham, of New York, N. Y.

THE GARWOOD ELECTRIC COMPANY, of Garwood, N. J., has been chartered, with a capital stock of $250,000 by E. A. Keegan, of Westfield, N. J.; G. W. Atkinson, of Newark, N. J.; A. K. Westerdahl and G. N. Williams, of Westfield, N. J.

THE MUTUAL ENGINEERING & CONSTRUCTION COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $15,000. The directors are: Oliver L. Badger, of Amityville, N. Y.; Thomas William Campbell and Joseph Montgomery, of Richmond Hill, N. Y.

THE PENNSYLVANIA MACHINERY COMPANY, of Westmont, N. J., has been incorporated, with a capital stock of $100,000, to manufacture steam, electric and gas power equipments. The incorporators are: G. R. Harvey, of Germantown, Pa.; H. J. McCormac, of Philadelphia, Pa., and J. Q. Adams, of Westmont, N. J.

THE CAMERON MOTOR COMPANY, of New York, N. Y., has been chartered, with a capital stock of $150,000, to manufacture motors, engines, machinery, cars, etc. The incorporators are: Eugene D. Alexander, of New Brighton, N. Y.; Robert R. Logan, of New York, N. Y.; Frederick Hildebrandt, Tompkinsville, N. Y.

New Incorporations.

LONOKE, ARK.—The Meto Valley Railway Company has been incorporated, with a capital stock of $32,000, to construct an electric railway from McCreanor southward in Lonoke County 16 miles to develop timber land. The incorporators are: E. C. Murray, S. M. Savage, C. P. Harnwell, E. S. Jett and R. J. Strong.

PINE BLUFF, ARK.—The Russellville Light & Water Company has been organized by A. Brewster, C. S. Bacon, Garland Brewster and A. J. Bacon. The company is capitalized at $100,000, and will take over the property and holdings of the Russellville-Ozark Light & Traction Company, which was organized about one year ago.

POWAY, CAL.—The Poway Valley Rural Telephone Company has been formed and the following officers elected: L. E. Kent, president; A. Flint, vice-president; O. H. Nelson, secretary, and E. G. Flint, treasurer.

AROMA, IND.—The Aroma Farmers' Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The directors are: William A. Noland, C. M. Harvey, H. E. Haworth, Henry Carpenter and I. N. Wells.

LOGANSPORT, IND.—The Logansport, Frankfort & Indianapolis Traction Company has been incorporated to construct an interurban railway connecting Logansport, Young America, Burlington and Frankfort, where connection will be made with lines for Indianapolis. The capital stock is placed at $25,000. The principal office of the company will be located at Indianapolis. S. H. Blakeslee is chairman.

OWENSBORO, KY.—Articles of incorporation have been filed for the Kern Electric Company, with a capital stock of $6,000, by W. E. Kern, E. L. Holbrook, C. G. Kern and Frank H. Miller.

WELLS, MAINE.—The Wells Electric Light & Power Company has been incorporated, with a capital stock of $10,000 and the following-named officers: J. W. Gordon, president; G. G. Hatch, treasurer, and J. H. Littlefield, all of Wells, Maine.

LUDINGTON, MICH.—The Interurban Electric Light & Power Company has been formed to build a dam and power plant at Hamlin Lake. The company is capitalized at $100,000, of which $50,000 is subscribed. The chief stockholders are George K. Shoenberger, Lewis J. Highland, John J. McDougall and Edwin R. Shoenberger.

BUFFALO, MINN.—The East Buffalo Rural Telephone Company has been formed for the purpose of constructing a telephone line on the St. Michael and Hanover Road.

PLATTSBURG, MISS.—The Plattsburg Telephone Company has been chartered with a capital stock of $20,000 by Dr. H. B. Watkins and others.

WEST POINT, NEB.—The German Telephone Company has been organized by the farmers of Bancroft and Neligh townships. The officers are: C. MacCarthy, president; William Vogt, treasurer, and J. Brehmer and J. Koehler, executive committee.

ALBANY, N. Y.—Articles of incorporation have been filed for the Central Station Operating Company to furnish gas and electricity for lamps in cities and villages in the state. The company is capitalized at $25,000,000 and the directors are: William H. Sheehan, Edward F. McAviney and Frank L. Smith, of New York, N. Y.

NEW YORK, N. Y.—The Hunter Electric Company has been incorporated, with a capital stock of $10,000. The directors are: Andrew Greenfield, George J. Constable, both of Brooklyn, N. Y., and Louis Seger, of New York, N. Y.

NEW YORK, N. Y.—The United States Light & Heating Company has filed articles of incorporation, with a capital stock of $10,000 and the following directors: John L. Linehan, John Miller, of New York, N. Y., and Frederick Holman, of College Point, N. Y.

PHELPS, N. Y.—The Phelps Home Telephone Company has been incorporated with a capital stock of $10,000 by C. M. Clark, H. F. Flint, of Clifton Springs, N. Y., and W. A. Hawe, of Phelps.

JACKSONVILLE, N. C.—The Onslow Telephone Company has been chartered with a capital stock of $20,000 by E. L. Cox and others.

RALEIGH, N. C.—Articles of incorporation have been filed for the Burgrahaw Interurban Company by C. E. W. Tenney, of New York, N. Y.; F. S. Jones, of Nashville, Tenn., and E. S. W. Dameron, of Burlington, N. C. The company is capitalized at $500,000 and proposes to construct an electric railway between Burlington, Haw River and other places near Burlington.

VALLEY CITY, N. D.—Articles of incorporation have been filed for the Dakota & Montana Telephone Company by Harold F. Pierce, Moose Jaw, Sask., Can.; F. E. Sexton, Hettinger, N. D., and W. J. Curren, Valley City, N. D. The capital stock of the company is $300,000.

SANDUSKY, OHIO.—The People's Light & Power Company has been incorporated, with a capital stock of $10,000, by George H. Kelly and others.

COOPERTON, OKLA.—The New State Telephone Company has been incorporated with a capital stock of $25,000. The officers are: W. R. McKee, of Cooperton, Okla., president; E. E. Carson, of Cold Springs, vice-president; B. M. Rogers, of Gotebo, secretary, and C. W. Smelzer, of Cooperton, treasurer.

OAKWOOD, OKLA.—The Oakwood Telephone Company has been incorporated by F. M. Dailey, Charles Hardin and N. B. Payne.

OAKWOOD, OKLA.—Articles of incorporation have been filed for the Oakwood Telephone Company by F. M. Daily, Charles Hardin and N. B. Payne.

TITUSVILLE, PA.—The Titusville Utilities has been organized to take over all the public utilities in Titusville. The company is capitalized at $6,000,000. Plans are being made to construct a railway to Cambridge Springs with a branch to Union City. Another railway will be built to Franklin and a through line will be built south to Butler and connect for Pittsburg, while an air line railway will be built from Butler to New Castle, a distance of 25 miles.

EL PASO, TEX.—The El Paso & Mesilla Valley Interurban Railway Company has been organized with a capital stock of $1,000,000 for the purpose of constructing a railway from El Paso to Las Cruces, N. M. The officers are: Z. T. White, of El Paso, president; O. H. Baum, of El Paso, vice-president; W. A. Sutherland, of Las Cruces, secretary, and Oscar C. Snow, of Mesilla Valley, secretary.

NORTH YAKIMA, WASH.—Articles of incorporation have been filed for the Lower Natches Telephone Company of North Yakima. The company is capitalized at $3,500, and the incorporators are: John B. Dobie, W. T. White, A. H. Blair, Lawrence Jacobsen and C. W. McCormick.

SEATTLE, WASH.—The American Power Company has been chartered, with a capital stock of $1,000,000, by G. L. Loope, Norman R. Smith and J. Ira Hawley.

UNIONTOWN, WASH.—The Uniontown Telephone Company has been incorporated, with a capital stock of $5,000, by Lambert Taufen, W. W. Miller and George A. Frissel.

WALLA WALLA, WASH.—Articles of incorporation have been filed for the Oregon-Washington Light & Power Company by E. S. Isaacs, John Smith, Max Baumeister, Samuel Drumheller and Gilbert Hunt. The company is capitalized at $1,000,000, and proposes to build and operate electric and street railways, railroads, etc.

BRANDON, WIS.—The Brandon Telephone Company has been incorporated with a capital stock of $4,000 by H. L. Brown, George E. Dickinson, G. G. Nemski, E. H. Sherwin and F. R. Schwandt.

EL DORADO, WIS.—The El Dorado & Friendship Telephone Company has been organized, with a capital stock of $5,000, to erect about 30 miles of telephone lines through the rural district.

DUBLIN, ONT., CAN.—The McKillop, Logan & Herbert Telephone Company has been incorporated, with a capital stock of $15,000.

MOUNT FOREST, ONT., CAN.—The Mount Forest, Wellington & Grey Telephone Company has filed articles of incorporation, with a capital stock of $10,000.

Legal.

DAYTON LIGHTING COMPANY RETAINS FRANCHISE.—The Dayton Lighting Company, of Dayton, Ohio, will retain its franchise rights under a decision reached recently by Judge Brown. Lack of jurisdiction in the questions raised by the city is given as the basis of the decision. The company was attacked on the allegation that it does not possess corporate capacity and that it merely represents a merger of the old Dayton Electric Light Company. It was claimed further that it was never incorporated.

LIMA, OHIO, MUNICIPAL PLANT.—City Solicitor Rogers, of Lima, Ohio, has filed suit in Lima to test the validity of the ordinance enacted providing for the construction of a municipal lighting plant. The petition asserts that the action was not according to law and that a restraining order should be issued to prevent the Board of Public Service from proceeding with the work. Under plans made by C. E. F. Ahlm, of Cleveland, Ohio, the construction work is progressing steadily. Bonds were sold to secure funds for the plant. The City Council repealed the ordinance at one time, but its action was vetoed by the Mayor. Now there is a fight between this body and the Service Board.

HUDSON RIVER POWER COMPANY SEEKS TO ANNUL CONTRACTS.—An application has been made to Judge George W. Ray, in the United States District Court, by Attorney Charles W. Andrews, Col. George W. Dunn and Milton De Lano, receivers of the Hudson River Power Company, of Glens Falls, N. Y., asking that the contract between the Oneida Railway Company and the Utica & Mohawk Valley Railway Company and the Hudson River Power Company may be abrogated. The receivers also seek to annul the contract between the city of Oneida and the Hudson River Power Company. The application is made on the plea that the power company is selling electricity to all three companies at a loss, and the statement is made that the Utica & Mohawk Valley Railway Company gave the Hudson Power Company $20,000 in 1908 to offset the loss in providing electricity in 1907. Archie D. Gibbs, of Norwich, N. Y., has been appointed special master to investigate the conditions of the contract.

Personal.

MR. WILLIAM ROBBINS McGOVERN has been appointed chief engineer of the Wisconsin Telephone Company.

MR. H. S. SALT, who for some years past has been vice-president and general manager of the Dale Company, has resigned these positions, the resignation to take effect Jan. 1.

MR. W. K. FREUDENBERGER has resigned as electrical engineer of the Tennessee Copper Company, Copperhill, Tenn., to accept a similar position with the Steptoe Valley Smelting & Mining Company, McGill, Nev.

MR. HAROLD BINNEY has formed a copartnership with Messrs. Seabury Cone Mastick and Herbert Gouverneur Ogden for the practice of patent, trade mark, copyright and corporation law, with offices at 2 Rector Street, New York.

MR. ALEX. ROTHERT, the electrical engineer of Riga, Russia, whose visit to this country was noted in our columns some months ago, has been appointed professor of electrical machinery at the Polytechnicum, Lemberg, Austria, and has left Riga to take up the work at Lemberg.

MR. W. W. WHEATLEY will become general manager of the Metropolitan Street Railway Company, Kansas City, Mo., on Jan. 1, succeeding Mr. Black, who resigned to go to San Francisco about a year ago. Mr. Wheatley is well known as an experienced manager and was recently connected with large properties in Mexico.

MR. R. S. HALE has been made superintendent of sales departments of the Edison Electric Illuminating Company of Boston. His duties will be enlarged over those of his recent position as general agent. The latter office will be filled by Mr. C. J. Hatch, formerly one of the company's specialists in charge of building installations.

MR. HENRY FLOY, who is consulting engineer for the Rascon Manufacturing & Development Company of Mexico, has just returned from a three weeks' trip to Rascon, Tampico, Guanajuato and Mexico in connection with the hydro-electric development of the El Salto Falls, which the Rascon company expects to have undertaken in the near future.

MR. CHARLES E. DUSTIN, well known in the electrical industry for the past 30 years, has become associated with Rossiter, MacGovern & Company, New York, dealers in new and second-hand machinery. The prominent position Mr. Dustin has occupied in the electrical field, as well as his extensive acquaintance, augurs well for the success of this alliance.

MR. L. W. BROWN.—We are informed by the Allis-Chalmers Company, of Milwaukee, Wis., that Mr. L. W. Brown, who for the past 10 years has held a responsible position with the Allis-Chalmers Company, has resigned, with the purpose of enabling himself to regain his health. He retires for the present with the regret of his former employers and associates.

PROF. DR. A. RAPS, director of the telephone and telegraph department of Siemens & Halske Company, Berlin, after spending several weeks in this country, especially in Chicago and the West, with an expert staff of engineers, sailed for home on Nov. 24. While here he made a close study of present telephonic development in the United States and added to his large circle of American friends and acquaintances.

MR. H. L. DOHERTY will direct his energies now to the development of Easton, Pa., where the gas and electric light properties have recently been acquired by himself and associates. Mr. George Williams will also be actively identified with the new enterprise. The *Scranton Telegram* has a very eulogistic article on both of them and their work in Scranton in connection with the plans for developing the new enterprise.

MR. H. E. CHUBBUCK, of Ottawa, Ill., secretary of the Illinois State Electric Association, who has heretofore been general manager of the Illinois Valley Traction Company and various other corporations owned by the McKinley syndicate of Northern Illinois, will, in addition, assume charge on Jan. 1 of the Illinois Traction System, operating electric railway, light and gas properties in and between various cities of Central Illinois. The Illinois Traction System is owned by a separate syndicate from that of Northern Illinois, Mr. W. B. McKinley being the head of both. Mr. Chubbuck's offices will be at Peoria.

MR. FRANK N. JEWETT, who has been for the past two years district sales agent of the Wagner Electric Manufacturing Company at Chicago, has been made general manager of sales for that company, with headquarters at the factory at St. Louis. Mr. John Mustard, who has been at the Philadelphia office, has been made assistant sales manager in charge of Eastern territory and will continue to have headquarters at Philadelphia. The electrical fraternity of Chicago regret very much the loss of Mr. Jewett from that city, but are glad to know that his ability has been recognized in this way and that the sales management of that company is to be placed in such excellent hands.

Obituary.

MR. JAMES GOODWIN, who for the past 10 years has been manager of the Power, Transit & Light Company, of Bakersfield, Cal., died Nov. 15, after a two weeks' illness. He leaves a widow and one son.

MR. JAMES FERGUSON, superintendent of the Safety Insulated Wire & Cable Company, Bayonne, N. J., died of kidney disease at his home in that place, Nov. 15. He was born in Nova Scotia 48 years ago, and a widow, two daughters and a son survive him.

MR. E. G. EBERHARDT.—We regret to note the death of Mr. Elmer G. Eberhardt, vice-president of the Newark Gear Cutting Company, on Nov. 21, at his home in Newark, N. J., of heart disease. He was 27 years old. Mr. Eberhardt was a graduate of Stevens Institute and Cornell University, and was formerly president of the Cornell Electrical Engineering Society and vice-president of the Cornell Mechanical Engineering Society. He was at one time in the Westinghouse Electric service, and was an associate member of the American Institute of Electrical Engineers.

Trade Publications.

CATALOGS WANTED.—Mr. J. M. Marshall, Swarthmore, Pa., writes us that he desires to obtain catalogs of the various electrical manufacturing companies of the United States, and requests that they may be forwarded to him.

CATALOGS WANTED.—Mr. J. S. Webster, electrical engineer, who has had his office at 21 North Sixth Street, Minneapolis, has located in the Phoenix Building and will be pleased to receive printed matter from manufacturers of lighting, power and railway equipment, as well as new devices in the line of supplies.

TRAIN LAMPS.—The Columbia Incandescent Lamp Company, of St. Louis, Mo., issued last week, more particularly for use at the car lighting convention, but also of general interest, a bulletin devoted to its train lighting lamps of carbon, tantalum and tungsten filament types. These are illustrated and set forth in considerable detail in the eight pages.

ILLUMINATION SPECIALTIES.—The National X-Ray Reflector Company, Chicago, Ill., has issued a new loose-leaf catalog, No. 15, describing the company's silver-plated corrugated glass reflectors and lighting specialties. The catalog is divided into 14 sections, each section containing from one to five pages of descriptive matter and half-tone illustrations of concentrating and distributing classes of reflectors for show-window lighting, as well as for the interior lighting of stores, churches and public halls. Special attention is given to the new "Poke Bonnet" and the "Helmet" reflectors manufactured by the company.

Business Notes.

E. W. PAUL & COMPANY, of Pittsburg, Pa., with offices in the Diamond Bank Building, have recently opened a laboratory in the Phipps Power Building to repair and calibrate wattmeters. They have prepared special rates and inducements for the central stations which do not have the necessary equipment or employees to test their house service and switchboard meters.

THE STOLZ ELECTROPHONE COMPANY, Chicago, Ill., has recently rented four floors of a building at 280 East Ohio Street, at which place its well-known electrophones will be manufactured. The company's business has increased to such an extent that it has found it necessary to

secure larger quarters than it has occupied heretofore. The sales office of the company will still be maintained at 92 State Street.

THE ATLAS CAR & MANUFACTURING COMPANY, of Cleveland, Ohio, has received an order from the government for 15 electric locomotives and 30 automatic electrically driven cars for use in Panama. In addition, the company is to furnish a number of cars designed to carry buckets of cement and rails for the tracks, with other equipment. The order amounts to about $200,000, and the equipment is to be installed on the ground within six months.

NERNST LAMPS.—An order has been received by the Nernst Lamp Company for 3-glower lamps to replace the 6-glower Nernst lamps in the corridors of the Frick Building, Pittsburg. Nernst lamps have been used in this magnificent building for the past five years. The new lamps will give the same volume of light as the old, at a saving of 25 per cent in the current consumption. Besides this, they have the advantage of greatly simplified renewal at a material reduction in cost.

THE FEDERAL SIGN SYSTEM announces that its general offices will be moved on Dec. 1 from 317 West Forty-second Street, New York City, to 501-2-3-4 Home Insurance Building, Chicago, Ill. This company acts as sales manager for the Federal Electric Company and has branch offices at New York, Philadelphia, Cincinnati, Louisville and Kansas City. Mr. H. F. Markham, formerly sales manager of the Federal Electric Company, has been made sales manager of the Federal Sign System. Mr. G. G. Beck, formerly connected with the sales department of the Federal Electric Company, Chicago, Ill., has been appointed purchasing agent of the company.

SUPPLIES AT ASHLAND, PA.—Mr. Edgar Llewellyn, who for the last four years has been engaged in superintending the installation of electric power and lighting in the Shenandoah and Shamokin divisions of the Philadelphia & Reading Company, has tendered his resignation. He has decided to enter the electrical contracting and engineering field, with headquarters at Ashland. He is well equipped for his new undertaking by his many years' experience in the electrical field, having been employed in a responsible position by one of the largest steel companies in Pennsylvania. The new firm will make a specialty of high-grade electric work, electric wiring and the electrical illumination of residences, stores and large buildings.

GEORGE BENDER.—This New York firm reports that there is a heavy demand at this time for second-hand dynamos and motors. Among the recent sales made in this line are: 50-hp dynamos, to J. W. & J. B. Cornell Iron Works, New York; motors, 40 hp, National Lead Company, Brooklyn; 35 hp, Chrome Steel Works, Chrome, N. J.; 20 hp, Singleton Silk Mills, Dover, N. J.; 50 hp, Edison Phonograph Works, East Orange, N. J.; 20 hp, Fibre Products Company, Framingham, Mass.; 10 hp, Mitchell Hardware Company, Ashtabula, Ohio; 15 hp, Standard Roller Bearing Company, Philadelphia, Pa. Fifteen motors were sold to the International Cork Company, Brooklyn, and five to the Buzzini Equipment & Installation Company, New York.

U. T. HUNGERFORD BRASS & COPPER COMPANY.—In the dissemination of knowledge by printing and illustration the art of the electrotyper has become an extremely important one. This industry has become a regular and a constantly increasing consumer of copper. The expansion of this industry commenced with the introduction of dynamos to take the place of batteries for depositing the copper, and since that time the U. T. Hungerford Brass & Copper Company, New York, has made a specialty of the production of high-grade copper anodes for electrotypers' use. It uses only the purest copper obtainable for this purpose and its anodes are used by the United States Printing Office and by thousands of electrotypers distributed throughout the United States.

CHICAGO ELECTRICAL SHOW.—The outlook for Chicago's fourth annual Electrical Show, which is announced to open in the Coliseum Saturday afternoon, Jan. 16, and run until Saturday night, Jan. 30, is the most gratifying in the history of these great trade expositions in America. With the show still two months away, more than 75 per cent of the space is sold, and the list of exhibitors includes many of the leading electrical concerns of the United States and Canada. Much of the remaining space is tentatively disposed of, and there is every reason to believe that everything available will be under contract before Dec. 15. Among the concerns that have already contracted for space are: Crane Company, Commonwealth Edison Company, Wagner Electric Manufacturing Company, Federal Electric Company, Cutler-Hammer Company, Pyro One Light Sign Company, *Popular Mechanics*, McDowell, Stocker & Company, Shelton Electric Company, Lindstrom, Smith & Co., Western Insulation Company, Murphy Electricity Rectifier Company, National Battery Company, Perfection Vacuum Cleaner Company, Chicago Fuse Wire & Manufacturing Company, Electric Appliance Company, The Excello Arc Lamp Company, Kellogg Switchboard & Supply Company, The Stoltz Electrophone Company, Stromberg-Carlson Telephone Manufacturing Company, Mathias Klein & Sons, Telephony Publishing Company, Manhattan Electrical Supply Company, Ft. Wayne Electric Works, ELECTRICAL WORLD, Benjamin Electrical Company, *Electrical Record*, Central Electrical Company, International Correspondence Schools, McRoy Clay Works, National Electric Lamp Association, Chicago Pneumatic Tool Company, Electrocraft Publishing Company, Robbins & Meyers, Appleton Electric Company, United Pump & Power Company, *Popular Electricity*, Chicago Telephone Company, Swedish-American Telephone Company, Westinghouse Company, Swedish Vibrator Company, Western Electric Company, Electrical Testing Laboratories, New York; *Western Electrician and Review*, Electric City, General Electric Company, North Shore Company, Pacific Electric Heating Company and Electric Storage Battery Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 17, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

903,826. MANUFACTURE OF METAL FILAMENT LAMPS; William C. Arsem, Schenectady, N. Y. App. filed March 16, 1907. Joins filament to conductor by electrically heating joint and simultaneously projecting thereon a jet of reducing gas inclosed in a jet of inert gas.

903,829. DYNAMO-ELECTRIC MACHINE; Bernard Arthur Behrend, Norwood, Ohio. App. filed Jan. 31, 1906. Ventilating ribbed separator for armature cores.

903,860. INCANDESCENT LAMP; John W. Howell, Newark, N. J. App. filed Nov. 17, 1907. Secures filament to wire by fusing down a portion of the wire within a protective envelope of fluid heavier than air.

903,861. ARC LAMP; Charles C. Hughes, Philadelphia, Pa. App. filed Oct. 13, 1906. Thermo-expansive hot wire regulator of nickel, copper and lead for feeding carbons of arc lights.

903,871. ELECTRIC TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed July 8, 1905. Means for impressing alternate positive and negative impulses of uniform duration on a cable, the intervals between impulses giving the code. Polarised syphon recorder used.

903,875. SYSTEM OF ELECTRICAL INSULATION; Fred M. Locke, Victor, N. Y. App. filed March 20, 1907. High-voltage insulator made up of a series of sets of petticoat insulators nested together with supporting ties leading from the bottom of the insulator of one set to the top insulator of the next set.

903,881. COMMUTATOR NECK OR LEAD; Ashley P. Peck, Milwaukee, Wis. App. filed Nov. 9, 1905. A commutator neck or lead composed of a plurality of U-shaped strips nested together.

903,892. FLUID PRESSURE SYSTEM; William F. Schneider, Norwood, Ohio. App. filed April 29, 1907. Air brake for trolley cars. Electric motor drives air compressor. Motor circuit controlled by two magnets, one energized when pressure in one air reservoir reaches a maximum, the other when pressure in other air reservoir reaches a minimum.

903,898. AUTOMATIC INDICATOR FOR TELEPHONES; Richard Sedgewick, Richmond, Ind. App. filed July 29, 1907. A dial indicator in a telephone stand for automatically bringing into view the number of the party called and means for automatically returning the indicator to normal on the commencement of a new call.

903,923. METHOD OF AND APPARATUS FOR RELIEVING WIRE CIRCUITS OF ELECTROSTATIC REACTION-CURRENTS; Nathaniel G. Warth, Columbus, Ohio. App. filed Sept. 16, 1907. Connects combined inductance and non-inductance coils so as to "load" the line and grounds them at predetermined points.

903,927. DRAWBRIDGE CIRCUIT CONTROLLER; Frederick A. Wendler, Elizabeth, N. J. App. filed May 17, 1907. Circuit breaker for drawbridges with one switch member yieldingly mounted to avoid injury to the breaker when the drawbridge is moved.

903,939. ANODE; Robert J. Wisnom, Virginia City, Nev. App. filed May 7, 1907. A grooved rail with openings and rods passing through the openings with a metallic strip in the groove joining the rods together.

903,945. ELECTROMAGNETIC CLUTCH; Heinrich Ast, Vienna, Austria-Hungary. App. filed June 15, 1906. Two clutch disks with air gap between and two heavy friction faces arranged for adjustment to compensate for wear.

903,951. PROCESS FOR THE ELECTROLYSIS OF LIQUIDS; Jean Billiter, Aschersleven, Germany. App. filed Aug. 3, 1908. Feeds the liquid (chlorid) to an upper chamber, in which it is heated, draws it by suction into a lower chamber, separated from the upper by a diaphragm.

903,966. LAG INDICATOR; William H. Freedman, Burlington, Vt. App. filed June 13, 1903. Measures "lag" of alternating current with instrument having a circular magnetic core carrying a winding in series with circuit, together with an inner movable core and coil thereon connected in pressure relation to circuit and a brake and pointer for inner core.

903,970. APPARATUS FOR INDICATING THE WATER-LEVEL IN BATHS; Paul Stern Von Gwiazdowski, Berlin, Germany. App. filed May 15, 1908. Specific construction of float and alarm operating mechanism.

903,972. PIGTAIL-BRUSH; Lee Carroll Hawley, Cleveland, Ohio. App. filed Feb. 13, 1908. Connection from brush to carbon to reduce resistance. Hole in carbon with rivet and braided pigtail embracing rivet.

903,987. CONTACT DEVICE; Frank B. Klopf, New York, N. Y. App. filed Dec. 13, 1906. Noiseless shoe for elevator signaling systems provided with a spring-pressed, pivoted contact member, yielding in two directions, mounted on the car, and adapted to contact with the fixed shoe in the shaft.

904,001. ELECTRIC SECONDARY CLOCK; Horace B. McCabe, Chicago, Ill. App. filed Nov. 12, 1906. Ratchet mechanism for driving hands of clocks. The stop for the actuating pawl has an engaging surface outside of plane of wheel.

904,011. OUTLET-BOX; Erwin L. Pierce, Everett, Mass. App. filed Aug. 31, 1907. Has openings for different sizes of conduits with removable stopper rings so that one may be removed to make an opening for one size and two for a larger size.

904,018. ELECTRICAL SIGNALING SYSTEM; Joseph F. Sauer,

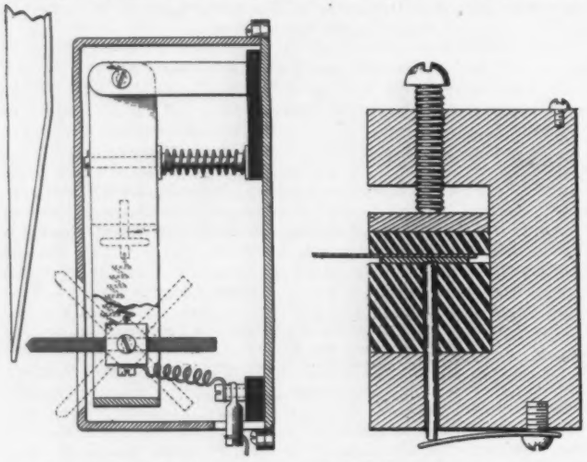
Wheaton, Ill. App. filed April 10, 1906. For steam or electric railways in which high-tension current operates signals. Provides a controlling relay actuated by a temporary circuit, and then by a holding circuit, and then establishes a circuit which neutralizes the armature holding inductance without disruptive discharge.

904,031. TRAPPINGS FOR HORSES; Chelsea L. Warner, Cincinnati, Ohio. App. filed June 2, 1906. Incandescent lamps for harness connected to a conductor embedded in the harness.

904,042. SWITCH-OPERATING MECHANISM; Robert Brown, Westminster, London, England. App. filed July 25, 1906. Electric switches in a closed conduit throw in contacts above street surface, the switches being actuated by a member on the car. Details in construction of actuating device.

904,069. INSULATOR; Willard H. Kempton, Trimble, Ohio. App. filed Dec. 16, 1907. For guy wires for electric railways; made of sections connected by cylindrical shell with detailed construction of shell and section.

904,070. PROCESS FOR EFFECTING CHEMICAL ACTION IN GASES; Dimmitt R. Lovejoy, Niagara Falls, N. Y. App. filed Feb.



903,987.—Contact Device. 904,222.—Oscillating Detecting Means for Receiving Intelligence Communicated by Electric Waves.

18, 1903. Forms oxids of nitrogen by subjecting air to radium and blowing the air in close proximity to electric arcs.

904,071. APPARATUS FOR CHEMICALLY COMBINING GASES; Dimmitt R. Lovejoy, Niagara Falls, N. Y. App. filed Feb. 18, 1903. Carries out part of process of 904,070 by rotating a shaft carrying electrodes near other fixed electrodes so as to rapidly form, draw and extinguish arcs. Air is drawn by the arcs.

904,072. PROCESS OF CHEMICALLY COMBINING GAS; Dimmitt R. Lovejoy, Niagara Falls, N. Y. App. filed Feb. 18, 1903. Subjects gases to electric arcs and refrigerates the product so as to make liquid nitrous oxids.

904,073. APPARATUS FOR EFFECTING CHEMICAL ACTION IN GASES; Dimmitt R. Lovejoy, Niagara Falls, N. Y. App. filed Feb. 18, 1903. Apparatus for carrying out process of 904,070 by passing air through a chamber containing radium and a rotating shaft carrying one set of electrodes adapted to pass near another set of electrodes so as to rapidly form and break arcs.

904,077. METHOD OF UNITING A FLEXIBLE TO A SOLID BODY; Cyril Douglas McCourt, Balham Hill, London, England. App. filed March 14, 1908. Makes pigtail brush by making an aperture in the carbon, fitting therein a smaller copper wire and filling the space between wire and carbon with powdered lead under pressure.

904,097. CONNECTOR; Mertie Ong Spring, Schenectady, N. Y. App. filed Nov. 12, 1904. Makes a T-joint between busbar and lead. Two reversely threaded terminals are respectively clamped to bus and lead. A nut turned by a wrench couples them. A protective insulated bushing surrounds the nut and is spaced therefrom.

904,105. TELEPHONE-EXCHANGE SYSTEM AND APPARATUS; Dudley B. Wick, Jr., Cleveland, Ohio. App. filed Sept. 8, 1904. The cord circuit is provided with a controlling relay, having opposing windings, supervisory signals governed partially by said relay, a circuit serially containing the opposing windings closed when the jack is inserted so as to feed current to the relay without exciting it, and a second circuit containing a relay winding closed upon the insertion of the other plug in its jack.

904,115. STORAGE BATTERY; Rufus N. Chamberlain, Depew, N. Y. App. filed Feb. 6, 1906. Details for closing the top of the storage battery.

904,116. RAILWAY BLOCK-SIGNALING SYSTEM; Harry M. Coulter, Chicago, Ill. App. filed April 8, 1907. Details improvement on inventor's prior patent, 794,784.

904,128. ELECTRIC CLOCK; Robert D. Hickok, Atlanta, Ga. App. filed March 27, 1908. Pendulum rod provided with armature and adjustable spring carried by armature to close clock circuit at a minimum swing of the pendulum.

904,130. PROCESS OF MAKING FILAMENTS FOR LIGHTING AND HEATING; Georges Michaud and Eugene Delasson, Paris, France. App. filed Aug. 18, 1905. Mixes alumina and oxids of thorium, etc., reduces to a powder, fuses and makes a filament.

904,157. COMBINED TELEGRAPHIC TRANSMITTER AND TYPE-WRITING MACHINE; Augustus G. Snyder, Ilion, N. Y. App. filed April 8, 1904. A series of stationary contact pieces and of reciprocating contact pieces in an electric circuit for transmitting signals, a series of keys, and means for mechanically connecting the reciprocatory pieces to the keys at will.

904,185. ARC-LAMP; Edward O. Dworak, Chicago, Ill. App. filed July 16, 1906. Inclined carbons which are fed to a common point so that the arc does not shift. Details in feed mechanism.

904,194. REGULATION OF POLYPHASE FURNACES; Richard Fleming, Lynn, Mass. App. filed Feb. 13, 1908. Establishes an artificial neutral point outside the furnace and measures voltage between it and the electrodes.

904,222. OSCILLATION-DETECTING MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES; Greenleaf Whittier Pickard, Amesbury, Mass. App. filed March 11, 1907. Thermoelectric receiver of molybdenum and sulphur acting as a rectifier.

904,248. MEANS FOR REMOVING STATIC ELECTRICITY; William H. Chapman, Portland, Maine. App. filed Feb. 18, 1907. Removes charge from paper in printing presses, by a conductor with points embedded in a non-conducting strip, the points being flush with the air.

904,263. PROCESS OF OBTAINING METALS FROM THEIR ORES; Karl Kaiser, Berlin, Germany. App. filed June 22, 1906. Process of obtaining zinc and iron from pyrite residues in smelting works (or metals from ores) by melting in electric furnace, then blowing air into mass, then carbon monoxid, condensing volatile vapors (zinc) and running molten metal (iron) into molds.

904,280. MAGNETIC SEPARATOR; Marcus Ruthenburg, Lockport, N. Y. App. filed June 22, 1907. A vertical rotary shaft carries an electromagnet comprising opposed annular polar projections. Two annular diaphragms extend between them. An endless belt conveyor extends between the diaphragms in eccentric relation to the rotary magnets.

904,359. TROLLEY-HARP; Joseph Pensis, Speers, Pa. App. filed Jan. 31, 1908. Prevents wheel from leaving wire. The wire lies between the wheel and a pivoted bar which yields in passing a hanger.

904,363. ATTACHMENT FOR TROLLEY POLES; Constantin Buggaber, Buffalo, N. Y. App. filed May 28, 1908. Prevents breaking contact if wheel leaves wire; a harp will then make the connection.

904,367. RELAY FOR TELEGRAPHS; James Scotland, Hearts Content, Newfoundland. App. filed July 10, 1907. Has a cylindrical armor and core, each slotted, to assist in demagnetization, and insulation separating core from armor.

904,369. INSULATING BUSHING; Louis Steinberger, New York, N. Y. App. filed July 12, 1907. Has a projecting portion forming a shed, the top extending beyond the bottom with means for supporting a conductor within the bushing.

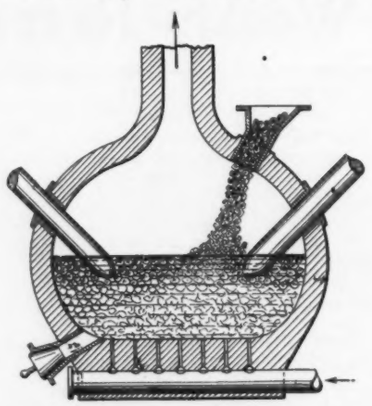
904,370. DISK STRAIN INSULATOR; Louis Steinberger, New York, N. Y. App. filed Jan. 20, 1908. Details to make it moisture proof.

904,415. WATCHMAN'S TIME REGISTER; George W. Ellis, Germantown, Pa. App. filed July 3, 1908. A clock movement partly closes a circuit at intervals which enables watchman to complete circuit and thus actuate register wheels. Details.

904,441. COMBINED TELEPHONE EXCHANGE AND ALARM SYSTEM; John Morris Latimer, Philadelphia, Pa. App. filed April 21, 1900. Telephone circuit from call box grounded at exchange, a local alarm apparatus for grounding circuit, a battery in the alarm circuit, a neutral relay at the exchange responsive to currents controlled by the local alarm apparatus and not to talking currents, and an alarm receiving apparatus independent of telephone circuit and controlled by the relay.

904,458. JUNCTION BOX; John N. Scism, Syracuse, N. Y. App. filed Jan. 13, 1908. A metal shell open at one side, a metal plate over the opening, arms pivoted to the plate with threaded apertures at one side of the pivots, and friction means for retaining the arms in their adjusted positions.

904,462. INTERMITTENTLY DRIVEN MECHANISM ADAPTED FOR CONSTANT DRIVING; Horace H. Taylor, San José, Cal. App. filed July 13, 1908. Relates particularly to cooling systems for cars in which is employed an ordinary ammonia cooling system with pumps, an intermittently driven shaft, a dynamo driven thereby, a storage battery adapted to be charged by the dynamo, a motor adapted to be operated by current from said battery, a second shaft



904,263—Process of Obtaining Metals from their Ores.

adapted to be driven either from the first shaft or by the motor, and an automatic control whereby the second shaft is constantly driven.

904,467. ELECTRIC-LIGHTING DEVICE; Clarence Wheeler, Rochester, N. Y. App. filed Sept. 17, 1907. Cigar lighter. Details.

904,476. ATTACHMENT FOR INCANDESCENT LAMP SOCKETS; Henry H. Ham, Shrewsbury, Mass. App. filed May 12, 1906. A wire arm for holding the cord of a pull-cord switch out of contact with the shade to prevent breakage of the latter when cord is pulled.

904,482. INCANDESCENT LAMP; John W. Howell, Newark, N. J. App. filed Nov. 17, 1906. A vessel contains carbon dioxide. A jet of reducing gas is projected into said vessel and an arc lamp in the vessel fuses the wire of the lamp to the filament.

904,486. PROTECTIVE APPARATUS FOR SWITCHBOARDS AND THE LIKE; William Kaisling, Chicago, Ill. App. filed Oct. 5, 1903. Protects against sneak currents in telephone switchboards by providing a heat coil arrester having a body and circuit breaker extending through it and longer than the body with means for forcing relative movement between body and circuit breaker under undue heat. The device is reversible.

904,491. TROLLEY HEAD AND HARP; Charles E. Marks, Virginia Beach, Va. App. filed Sept. 6, 1907. Prevents trolley wheel from leaving wire. Harp has openings to carry wheel. Also idler wheels in harp extending above wire. Details.